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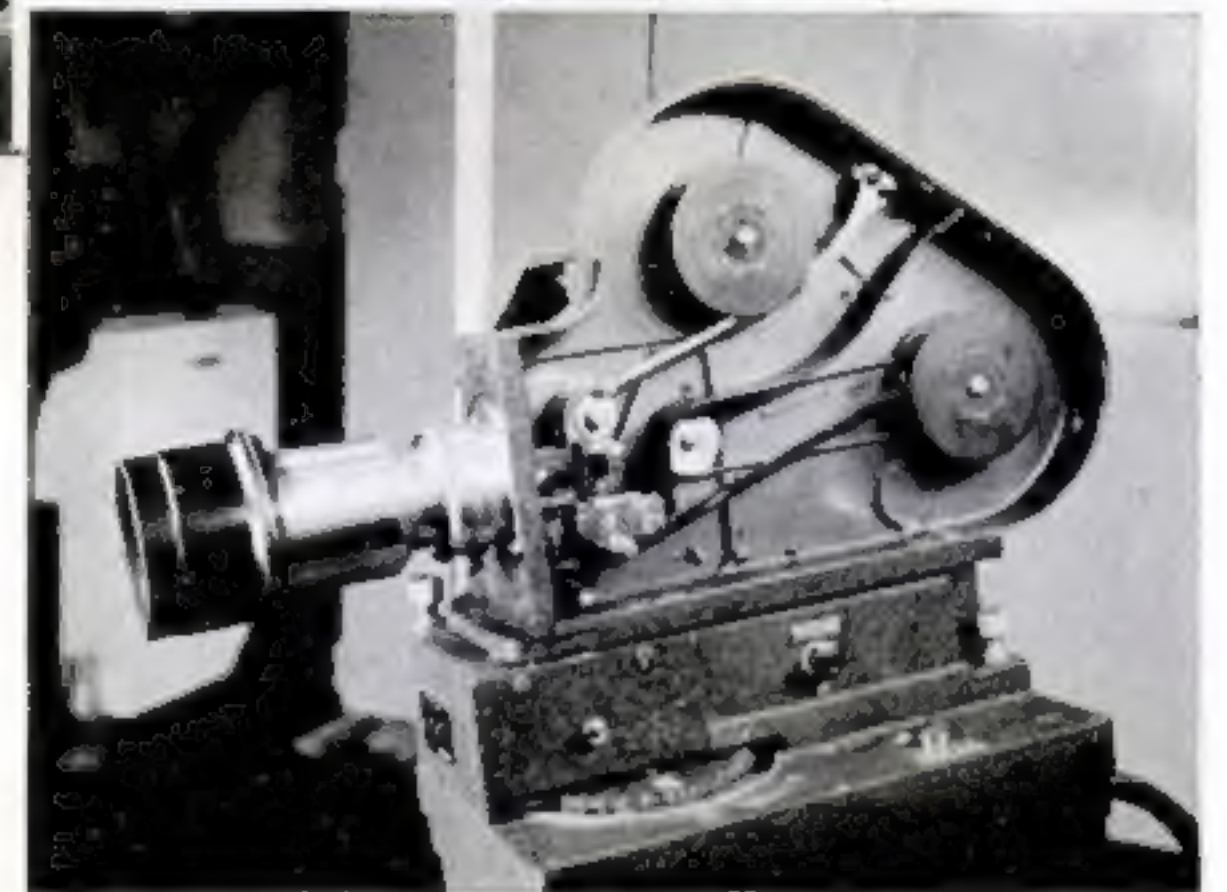
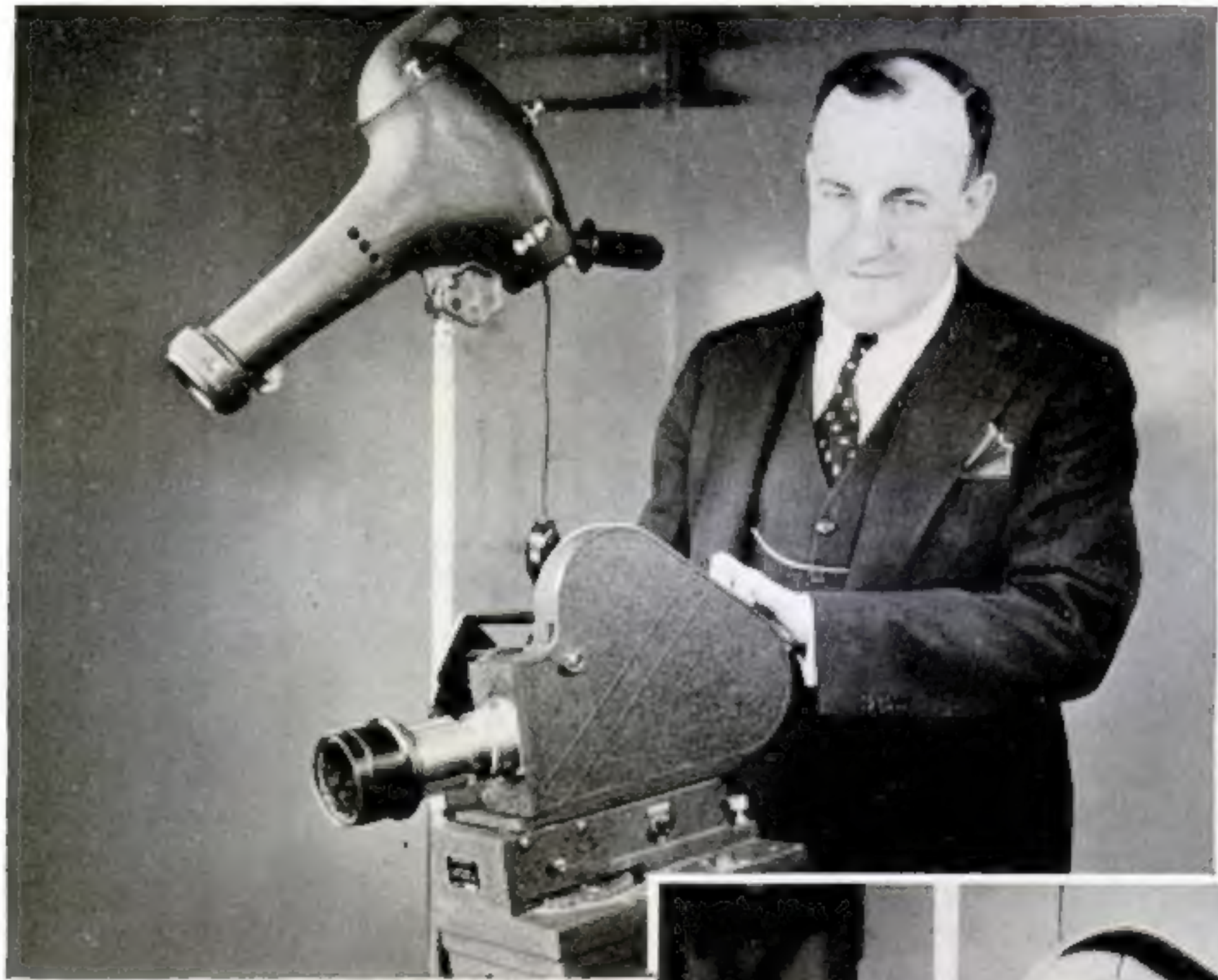
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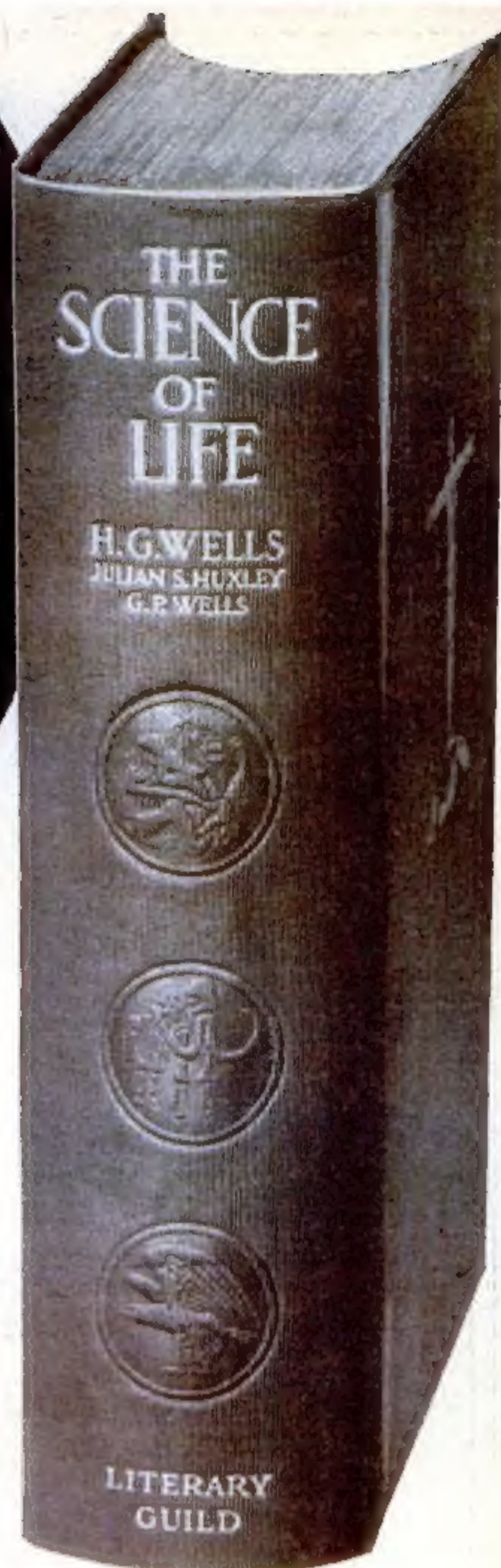
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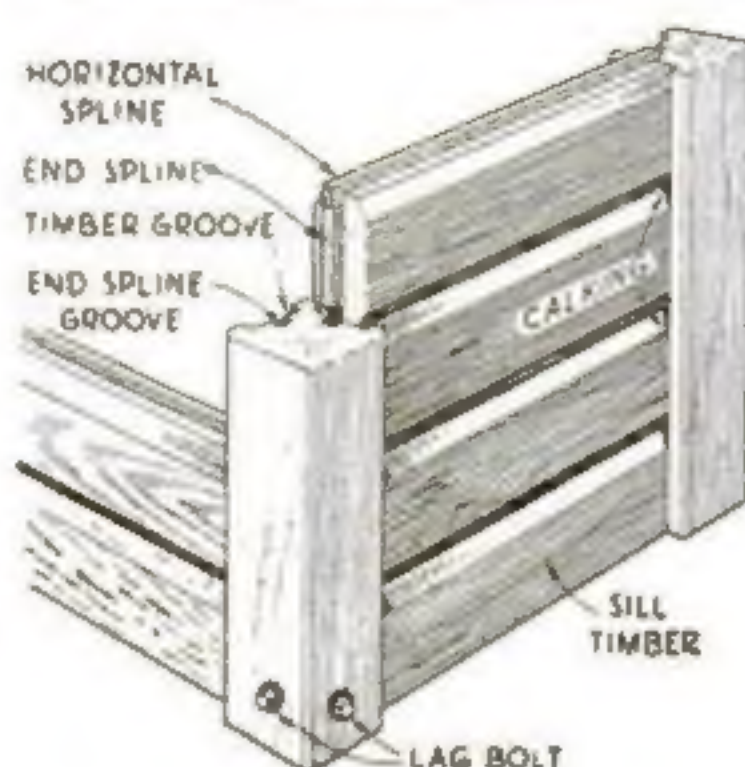
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MOTORISTS WISE  
**SIMONIZ**



Workmen erecting a cabin with precut lumber. Sides and frames are held together as shown at the left



**S**MALL cottages and summer homes can be constructed quickly and inexpensively with a new form of precut lumber recently placed on the market. Provided with tongues and grooves and cut to size, the boards are assembled into walls simply by sliding them into grooves cut in the door and window frames and corner posts. No nails are needed in the construction, which is done in the manner shown above.



Redecorating a room with a new casein paint that dries quickly without objectionable odor

## HANDY AIDS FOR Home Builders

### ALL-METAL AWNING IS RUSTPROOF

RESEMBLING a Venetian blind, a new-type, all-metal window awning is both storm- and rustproof. It can be adjusted to any position by means of a crank and when raised takes up little space. Once installed, it never has to be taken down, even during the winter.



This metal awning can be left out all year

### QUICK-DRYING PAINT LEAVES NO ODORS

BECAUSE it is both odorless and quick-drying, a recently marketed wall paint made from casein, is particularly well suited to refinishing work. Sold in paste form to be thinned with water for use with either a brush or a spray gun, the new finish has good hiding power and can be applied directly over wet plaster. Since each coat dries in less than an hour, a room can be completely redecorated with a two-coat job in a single day. Once the surface has become thoroughly dry, it can be cleaned by sponging it lightly with a mild soap and water.

# Happy Holiday

**T**HIS is vacation time. Millions of people are away. Other millions are getting ready for trips—to mountains and seashore and lakes—to the country or to foreign lands.

Distance doesn't matter any more. Your family may be scattered temporarily to the four winds—children at camp, mother visiting back home, father at the office—but all may be reunited again, instantly, by the simple calling of a number.

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# Our Readers Say



## Reading Article Puts Color Into His Microscope Work

BEING an ardent microscopist I have built my own microscope, but, like most amateurs, I had more enthusiasm than money and it wasn't possible to obtain the best of lenses.

The eyepiece is a good one, but the objective, well—the less said about it the better. I had been trying out some color filters without any real knowledge of what I was doing until along came the article "Rainbow Tints Give Greater Power to Your Microscope,"

by Morton C. Walling, in a recent issue. This cleared up a number of things that were bothering me, and I went ahead with added zest. It is rather peculiar, but I find that a dark-red filter is best suited for my needs, and it brings out the outlines of foraminifers in sharper detail.—J.A.E., Hull, England.

JUST LIKE THE GALS, WHAT A DIFFERENCE A LITTLE COLOR MAKES



## Trailer Homes and Motor Shops Bring Visions of Mobile Town

A FEW months ago, your excellent magazine told how thousands of families are traveling around the country, making their homes in trailers. Looking through the August issue, I find further indications that all the activities of daily life are being motorized. On page 10 there is a crime-detection laboratory housed in a trailer; on page 17, a traveling cheese laboratory is pictured; a dry-cleaning and tailoring shop on wheels appears on page 26; page 36 contains (of all things) a mobile telephone exchange. A little more of this, and we'll be able to assemble a complete rolling community, with schools, shops, libraries, and all the other appurtenances of modern life mounted on wheels. A town could spin over the country in a cloud of dust, following the seasons or the whims of its citizens.—J.P., Salt Lake City, Utah.

## In Short, Does the Black Widow Mind Her Own Business?

THOSE pictures of the Black Widow spider and the little fly that is its natural enemy, which appeared in your last issue, were excellent. In reading the text, however, I got the impression that these spiders will bite a person even though they are not being molested. This inference does not tally with the evidence I saw in another picture. The photograph showed a scientist at Emory University, in Georgia, permitting Black Widow spiders to crawl over his hands and arms. There was a statement to the effect that the spiders will not bite except in defense. In other words, if you find one of these babies on you, is it best to await an opportune moment to shake yourself loose from it, or to smack down without delay?—D.L., Charleston, S. C.

ALL WIDOWS ARE DANGEROUS!

BOLONEY!



## Reader Wants To Hunt For His Animal Pictures

SOME humorist once quoted an Englishman as remarking, "What a beautiful day! Let's go out and kill something." Seriously, though, why doesn't some enterprising manufacturer bring out a "camera gun," designed especially for sportsmen, that would make it as exciting sport to photograph birds and other game as to shoot them? The instrument I have in mind would have the "feel" and trigger action of a regular gun, so that a person accustomed to handling firearms would take naturally to using it—somewhat along the line of the machine-gun cameras used by the Army to train aerial fighters. It would have standard gun sights, and a powerful telephoto lens of so narrow a field that expert aim would be needed to "shoot" anything with it—a real test of skill for a man with sporting blood. A lens like this would give such high magnification, like a telescope, that a bullseye shot of a deer in the woods or a bird in a tree top would be something worth showing around and bragging about. And the owner of a "camera gun" could laugh at game laws and closed seasons.—A.G.F., Rutland, Vt.

## That Was No Bug! That Was a Walking Stick

IT SEEMS you're trying to make the "walking stick" something it isn't. In your July issue, you referred to the walking stick as a bug. Strictly speaking, he's not a bug. A true bug is a member of the order *Homoptera*, while the walking stick is a member of the order *Orthoptera*. Jumping from walking sticks to automobiles, many of us, I believe, would like to have suggestions for tuning up our cars even though there may be nothing actually wrong with the mechanism. Information of this sort might head off future troubles. Maybe many readers use some little-known kinks to keep their cars humming in good style. How about suggestions along this line?—A.V., Boulder, Colo.

WHO SAYS I'M BUGS?



## Rain Makers, We Infer, Should Carry Umbrellas

YOUR recent article "Weird Schemes To Make It Rain" reminded me of something that happened when I was a boy out in Kansas. We were having the most gosh-awful drought you ever saw, and the farmers were faced with ruin if they didn't get some rain. Finally, a preacher in one of the towns announced that he was going to hold a meeting to pray for rain, and that he would keep it going until he got results. I can still remember how the people looked as they came in from all the surrounding country, raising great clouds of dust as they drove along the dry roads in their wagons and buggies. Well, the meeting had been going just two days, and was barely getting warmed up, when

there came a cloudburst that nearly washed the church away. Funny thing about it was that not a soul had brought an umbrella or a raincoat.—P.T., Philadelphia, Pa.

## Rear-End Mikes To Show Up Road-Hog Truck Drivers

SOME people condemn automobile-truck drivers as being discourteous; others disagree and defend them. Personally, I think the courtesy question rests with the individual driver behind the wheel of the truck. There is now, however, a means of settling this question. A German inventor has brought out a device which consists essentially of a microphone, installed at the rear of the truck and hooked up to a loudspeaker in the driver's cab. When the driver of a passenger car sounds his horn, signaling for the truck driver to pull out of the center of the road and let him pass, the driver of the truck hears this "honked" request very plainly, and there can be no excuse that the noise of his motor drowned the sound of the horn. If the truck is on a well-paved road, either he pulls over or he is discourteous. What you do in the latter case, I don't know—unless you shout a few remarks pertinent to the occasion in his rear-end microphone.—N.R.H., Detroit, Mich.

DESIGN FOR TRUCK BY 8,576,248 AUTO OWNERS



## Sounds Like a Bad Leak From a Naval Conference

IN THIS day and age, when strong emphasis is being placed upon larger and more adequate naval armaments and battleships, I still hear a lot of talk about the supremacy of the monitor and the dreadnought. To me this seems a little bit "screwy" and I would like to see P. S. M. publish an article or two on warships, their construction, the range and piercing power of different size shells, and other data pertinent to naval armament.—G. H., Telfordville, Alta., Canada.

## Getting Physical Work Mixed Up With His Physics

I AM a regular reader of your fine magazine and especially enjoy the Our Readers Say pages. The problems that are discussed there lead me to lay one before my fellow readers in the hope that they can help me solve it. If the "work" done on an object is the force exerted times the distance traveled, does this mean that a man who is exerting all his strength in trying to push a huge stone that he cannot move is doing no work at all? Was good old Atlas, who carried the world on his shoulders, just loaf-

ATLAS WAS'NT IN IT WITH US TAXPAYERS



ing? Maybe I'm wrong, but this has me puzzled and I would like to have some one explain what seems to me to be a paradox.—E.G.D., Jaro, Philippine Islands.

### **Wants Some One To Expand On Making Camera Bellows**

As a constant reader and a photo fanatic, I demand more about photography. Let's have some tips on indoor, daylight shots, on miniature photography, and on enlarging. Above all, give us something on how to make a simple homemade enlarger, especially the bellows. The construction of the bellows is the most nerve-racking thing imaginable. How is the darned thing folded? If any reader can answer just that one question I would be indebted to him—M. G., Brooklyn, N. Y.

OH, BOY! THE PHOTOGRAPHY PAGE !!



### **Suggests Low-Hung Lamps For Better Highway Lighting**

SAFETY lighting for highways, as described in the August number, interests me very much. After having a number of scares on poorly lighted roads, I came to the conclusion that poor lighting is worse than no lighting at all, but if highways can be correctly lighted it would certainly do much to make night driving safer and more pleasant. There is one method of lighting highways that I have never seen tried, but which I think would be extremely effective. If the lights were installed about three feet above the surface of the road, and properly designed, they would provide good vision, even on foggy nights, and would not be likely to blind the automobile drivers.—R.O.D., Tulsa, Okla.

### **O. T. Should Look On Page 22**

IN MY daily newspaper this morning, I found an item which should give encouragement to amateur astronomers, and to "hams" in other fields of science as well. It seems that one Leslie C. Peltier, a free-lance stargazer, has scored a "beat" on the professional observatories by discovering a new star. To my amazement, the item went on to say that this same fellow has made other finds in the suburbs of the solar system, including a brand-new comet. His achievement ought to be an inspiration to all amateurs because it shows that, even in this advanced age, the opportunities for discovery are not monopolized by the great research organizations and highly trained specialists. For my part, I'd like to know more about these amateur astronomers.—O.T., Atlanta, Ga.

### **He'd Scan Heaven and Earth With His Telescopes**

OTHER readers have been asking for articles on telescope mirrors and mineralogy and, while motions are in order, I just want to say that I hope you will soon bring out a series of articles on how to construct a solar telescope. In fact, it would be a good idea, I think, to tell about how to build both a solar and a terrestrial telescope, being sure to include the making of the lenses. I also agree with those who would like to see some articles on mineralogy.—R.E., Washington, D. C.



### **A Stratosphere Hook-Up To Put Earth To Work**

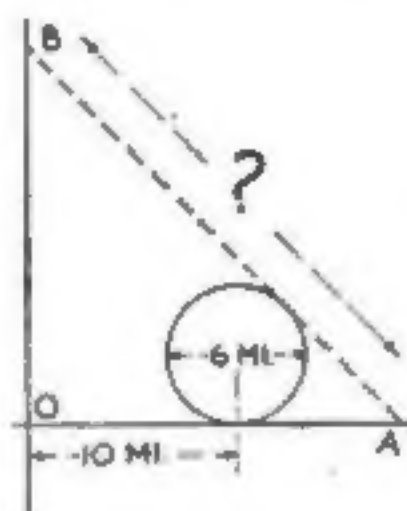
AS A TEST of wits, I recently asked a young student this question: If it were possible to anchor to earth a balloon floating in the stratosphere, would power be furnished by the pull on the wire exerted by the earth revolving beneath? His answer was that just as a large kite flying in a strong wind will drag a light boat through water, the extremely rapid flow of the earth's surface away from the lagging balloon would pull a movable mass. Of course a balloon could not support the twenty or more miles of wire necessary to anchor it but, as a problem, I think the question is both interesting and debatable. I would like to hear the opinion of some readers on this hypothetical question.—W.I.W., Los Angeles, Cal.

### **Ready To Cross Swords And Make Guns—of Wood**

How about those articles on fencing as suggested by several readers? I'm still waiting for them. Also, I would be grateful if you would grant the request of G.M., of Burlington, Vt., and give us plans for making wooden models of famous rifles. I have always wanted to make a collection of musket models.—A.E.P., Fitchburg, Mass.

### **Where Is Starting Point For This Bee-Line Road?**

WHAT has happened to all the mathematical sharks who used to infest Our Readers Say? They seem to have either given up or run out of ideas, so to start the ball rolling again here goes: Two roads intersect at right angles (at O in the diagram). There is a circular lake touching the road AO, at a distance of ten miles from O. Engineers want to build a road (AB) touching the lake as shown and being of the shortest possible length. What is the shortest possible length, and how far from O should the road start? In other words, what would be the length of OA to make AB the minimum?—F.M., Aurora, Ill.



### **Advocates Reincarnation Of Old, Worn-Out Shoes**

THERE are numerous ways and means of making profitable use of old inner tubes, bottles, tin cans, rags, and paper but I have never heard of any profitable way to put old scrap leather to use. Because of the cost of leather, disposing of this material in an unprofitable manner represents a great waste. Why couldn't all this leather be converted into some form of paper, into chemicals, dyes, floor covering, coats, ornaments, or even hog feed? Many uses, I believe, could also be found for this leather in the handicraft field where it might be made into useful and salable items. Along the same line, since there is a very limited market today for old paper, why couldn't it be soaked with refuse automobile oil and then be pressed into forms suitable for fuel?—V.L.M., Mt. Pleasant, Iowa.

### **Inventor Lets Sun Raise or Lower Awnings**

FOR the benefit of A.F.Y., of Newark, N.J., I would like to tell him that there is a way to avoid all the back-breaking work of maneuvering like an acrobat at a window just to get an unwilling awning to go up or down. I already have a patent on a device which even eliminates the use of cranks of any sort. In fact, the sun raises or lowers the awning through the action of an electric eye which

controls a small electric motor—letting down the awning when the sun shines or rolling it up when the sun is obscured.—S.Z., Jersey City, N.J.

### **Wants To Build Models Of Early Gasoline Buggies**

I HAVE constructed several models from your articles and blueprints. The building of them gave me great satisfaction, especially the ones by Capt. McCann and Donald Clark. How about running plans of simplified models of some of the early automobiles? These should appeal to many model builders. Also, why not give us an article on steam cars as suggested by a reader in a previous issue?—J.E., Kansas City, Mo.

IN MY MERRY OLDSMO-TUM TE TUM



### **Sealed-In Water, It Appears, Sets Up Own Antifreeze Action**

IN ANSWER to the letter sent in by L.B.K., of Cromwell, Minn., I want to say that water sealed, at four degrees centigrade, in a container that would not stretch or break, would remain a liquid no matter how much the temperature was lowered. My reason is this: Lowering the temperature would make the water attempt to expand, this in turn would create friction among the molecules, causing the water to become warmer and preventing it from freezing. The lower the temperature, the greater the friction, so that the two would counteract each other. In other words, although the temperature around the container were reduced, the temperature of the water itself would not be lowered enough to cause freezing.—H.E.I., Rogers, Ark.

### **Radio Waves, He Suggests, Might Govern Car Speeds**

ALONG with the plan for equipping autos with a telltale time-speed recorder, offered by S.S.I., of Savannah, Ga., I'd like to suggest that cars might be equipped with a radio-controlled governor. In congested sections of heavily traveled highways where the accident rate is high, a radio beam, constantly playing across the road, would be picked up by the governor and the speed of the car would be automatically reduced to a point considered safe for that particular area.—E.A.D., Yakima, Wash.

### **Sees Streamline Trains Ready But With No Place To Go**

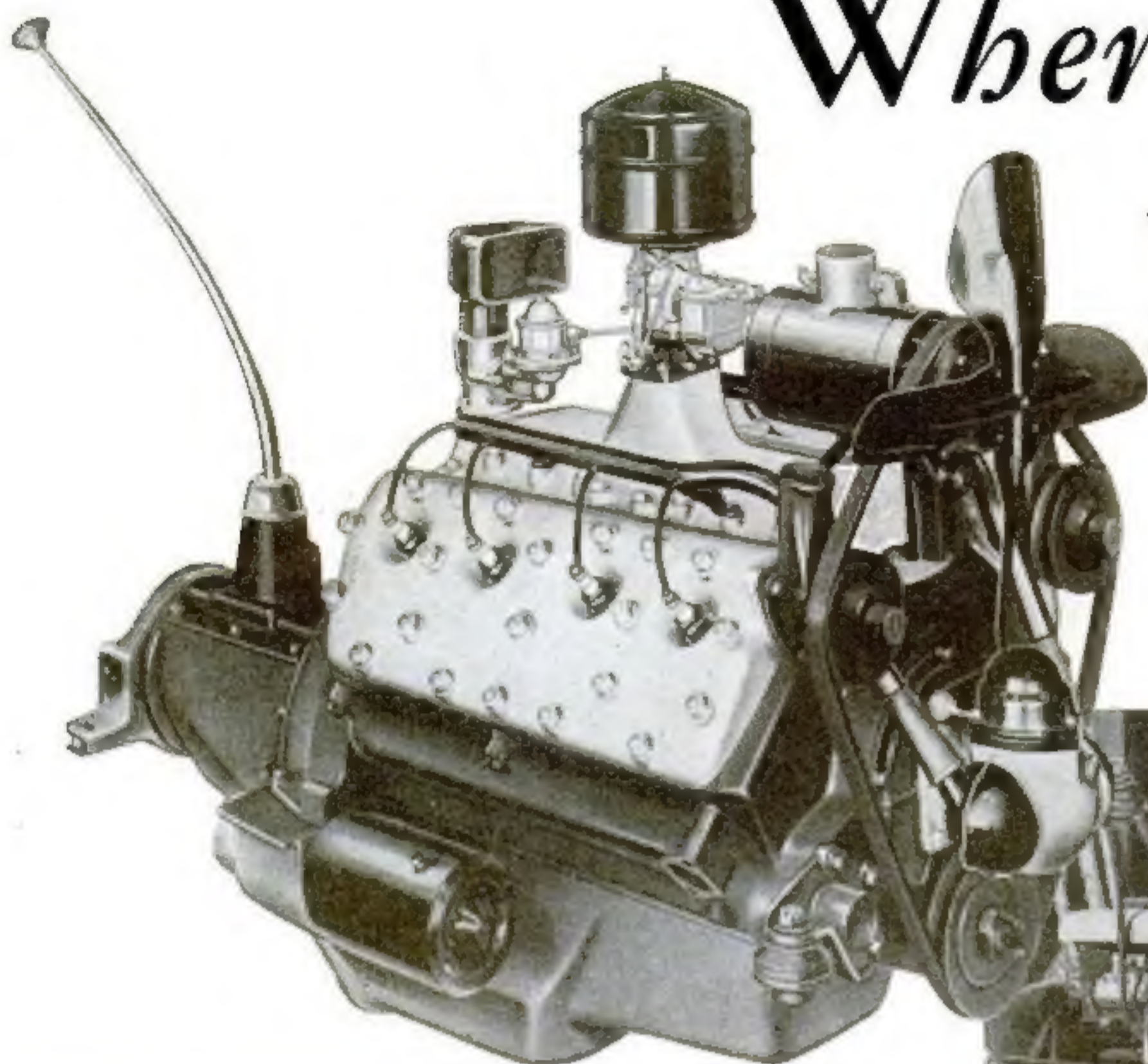
HASN'T the cart been placed before the horse in the designing and building of the new lightweight, high-speed streamline trains? By this I mean that these fast trains are now available for the railroads to buy but the railroads have only a relatively small amount of trackage over which trains of this type can be run. An authority on this subject recently stated that there were only about 20,000 miles of main-line trackage (about ten percent of the nation's total) which were equipped with the proper curves, grades, etc., to permit these new trains to operate at 100 miles or more an hour. Certainly there would be no advantage to the railroads if they spent large sums for these new trains and then were forced to operate them at fifty or sixty miles an hour.—A. O. R., Cincinnati, Ohio.

AW, PUT WINGS ON 'EM AND FORGET THE TRACKS!



# FORD V-8 ENGINES DO A JOB

*Wherever*  
**POWER**  
*is needed*



On half a hundred different types of jobs you'll find Ford V-8 Engines at work. They drive industrial locomotives. They run mine cars. They power motor boats. They operate farm machinery, sawmills, concrete mixers and rock crushers. And wherever they work you'll find them supplying economical, dependable power—often in service that requires unfailing operation day after day over long periods of time.

Ford V-8 Engines are built to a high degree of perfection. Power-machinery manufacturers appreciate the fact that in the entire engine-building industry they can find no closer limits of precision, no better manufacturing methods.



A 36-inch rock crusher operated by a Ford V-8 Engine.



Portable feed-grinding unit powered by a Ford V-8 Engine.

Ford power shoots these sprays to the highest branches.



Motor boats powered with Ford V-8 Engines show remarkable speed and economy of operation.

And owners of equipment agree in their praise of Ford V-8 Engines for their stamina, their unfailing power in hard service, their economy of operation and their low cost of maintenance.

Whatever the power job you have to be done, it will pay you to consider Ford V-8 Engines. Remember, too, that Ford Service is

Universal—that Genuine Ford Parts are available from every Ford dealer at standard reasonable prices. And in keeping with Ford Motor Company's established policy to maintain repair costs at a minimum, new low prices on many Genuine Ford replacement parts are now in effect.



FORD MOTOR COMPANY • DEARBORN, MICHIGAN

RAYMOND J. BROWN, *Editor*

# Television AND Pocket Radios

PROMISED BY LATEST  
SHORT-WAVE TESTS

FEW years hence, you may have a private radio wave length, just as you now have your own telephone number!

That is one of the spectacular developments recently predicted by David Sarnoff, president of the Radio Corporation of America. Exploration in the wilderness of ultra-high frequencies, he believes, will provide millions of new channels for private broadcasting.

Then the dream of midget stations—vest-pocket transmitters and receivers no larger than watches—may be realized. Already, successful tests along this line have been reported both here and abroad. From Rome, Italy, comes word of a feather-weight radiotelephone with which pedestrians and motorists can converse with friends while walking or riding down the street. Again, at the Democratic convention at Philadelphia, Pa., a micro-wave transmitter, hardly larger than a shoe box, attracted wide attention. It broadcast speeches from the floor of the

hall to a larger transmitter which put them on the air in a national hook-up.

One of the outstanding developments of recent months has been the advances

By **EDWIN TEALE**



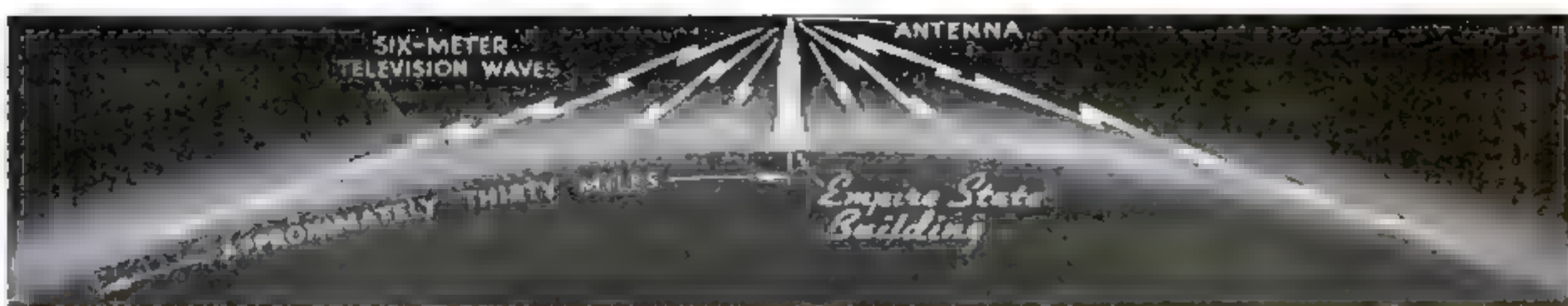
Workmen installing a lightning arrester to protect the antennas of a television station in the Empire State Building, New York City. Left, a modern television receiver with sight and sound circuits housed in a single cabinet



in the realm of communication. Curious new terms: "coaxial cables," "Christmas-tree antennas," "shoe-button tubes," "television snowstorms," form the milestones of this advance. Behind each of these additions to the vocabulary of the radio engineer lies a record of research and achievement.

Only the other day, another page was added to this record. Zigzag wires on top of a New York skyscraper sent off ultra-high-frequency waves which were picked up by a "turnstile" antenna in Philadelphia. In bridging that 100-mile gap, the waves opened up dramatic possibilities for the future.

The Morse code may become as obsolete as a prairie schooner! Written letters may leap through thin air with the speed



## A FAR HORIZON FOR TELEVISION

This drawing shows why television transmitting stations are located on tall buildings to give maximum sending range

# NEW METHODS OF COMMUNICATION ARE BEING DEVELOPED IN THE LABORATORIES OF THE BUREAU OF ELECTRICITY



## SENDING FACSIMILES BY ULTRA-SHORT WAVES

An operator preparing to send a message over the circuit that transmits pictures and drawings between New York and Philadelphia. The diagram at the right was sent through the air by this method. At the left are the antennas at the New York end of the new experimental circuit.



of light and be received in the handwriting of the person who sent them! Newspapers may be printed in your own home, going to press by radio!

Impulses reaching the Philadelphia antenna operate a secret mechanism in which a spiral bar moves swiftly over a sheet of carbon paper revolving on a drum, and leaves behind a perfect reproduction of a picture turning on a similar drum in a New York broadcasting studio.

Letters, pictures, newspapers, maps, fingerprints—all can be sent through the air by the new service at a cost of so much for each square inch. Four New York newspapers are reported ready to broadcast news editions by this method. Radio experts vision as a development of the future a supernewspaper flashed to home receivers from coast to coast. Sectional news would be inserted at the local broadcasting stations. Engineers are said to have designed a receiver for home use which could be

put on the market for approximately \$100.

In addition to transmitting facsimiles of letters and pictures, the new service can send messages by telegraph or automatic typewriter. With sufficient power, it could transmit 12,000 words a minute by teletype.

One dramatic feature of the demonstration was the use of a model of Morse's original telegraph key. The same broadcast that carried pictures across the ether transmitted a message tapped out by this pioneer instrument!

While facsimile, or still-picture, transmission is not new, the New York-Philadelphia service possesses radical features which promise much. It virtually eliminates the effects of static by use of a three-meter wavelength and booster stations along the way carry the broadcast to its destination at full strength.

In two American laboratories, not long

ago, scientists sent even shorter radio waves racing down hollow metal tubes. At both the Massachusetts Institute of Technology and the Bell Telephone Laboratories, the waves did an amazing thing. They traveled down the pipe like a voice in a speaking tube. Instead of spreading out, they ran along the inner skin of the electromagnetic pipe, apparently immune to static.

Such wave guides may be employed for carrying radio or television broadcasts from station to station. An even more spectacular application would be their use for shooting programs directly into the air without the use of an antenna. Experiments have shown that when the end of the tube is flared out like a horn, the waves are projected into space. Such "radio guns" would enable stations to aim broadcasts in any desired direction.

During the tests at the Massachusetts Institute of Technology, radio waves only one third of an inch in length were used. They had a frequency of 2,000,000,000 cycles a second or higher. The Bell laboratories employed waves a dozen times as long, but still well within the "radio wilderness" of ultra-high frequencies.

Hundreds of experimenters in all parts of the world are now exploring the possibilities of these high-speed waves. New



Pocket radiotelephone sets like this may soon make it easy for anyone to call up his home from the street

applications for them are popping up from week to week.

An eastern inventor, for example, has just given them the job of announcing streets and giving interesting bits of information to passengers on cars and busses. Tiny transmitters will broadcast automatically from phonograph records or films, their weak signals carrying for only half a block or so. Antennas on the moving vehicles will pick up the different broadcasts as they near the corners where the transmitters are located.

**A**NOTHER application for these "limited-range" stations is foreseen by the same inventor. In storms and fog, he declares, they can be used to warn airplane pilots of danger spots. When an airman picks up such a short-range signal, he will know he is close to an obstruction, just as the sound of a bell buoy warns a mariner he is nearing a reef. By placing tiny transmitters on mountain tops along commercial airlines, passenger planes could be kept from crashing into unseen peaks in fog.

Stretching sheets of radio waves into the stratosphere is another ingenious idea for detecting invisible planes in wartime. Thomas S. McCaleb, Harvard University scientist, has found that when a line of transmitters direct their signals upward, airplanes passing through the curtain of waves reflect some of them back to earth. By determining the positions of the sending and the receiving stations, he can determine the exact spot where the plane is flying. Such calculations would be of immense value in guiding the fire of anti-aircraft guns.

Another research worker at Harvard, Dr. Charles F. Brooks, director of Blue Hills Meteorological Observatory, recently

set a new distance record for ultra-short radio waves. Sent from an experimental station at Cambridge, the  $1\frac{1}{4}$ -meter waves traveled sixty-eight miles to another station at Mt. Wachusett, Mass. Ordinarily, the ultra-short waves disappear when they have traveled twenty or thirty miles. Unlike longer radio waves, they do not bend, and when they reach the curve of the earth they fly off into space. The limit of their range is usually calculated as the horizon. Consequently, the higher their source, the farther they travel.

It is for this reason that the tip of the Empire State Building, 1,200 feet in the air, was selected as the site for the sending antenna in the \$1,000,000 television "show" being put on by the Radio Corporation of America. Daily broadcasts are going out

to 100 receiving sets in the homes of picked engineers. Other sets in special motor cars roll along the streets to test reception in all parts of the city. When this elaborate tryout is over, the experts will know many things about the effect of static, the reception at various distances, the location of "dead spots," and the commercial possibilities of present-day television.

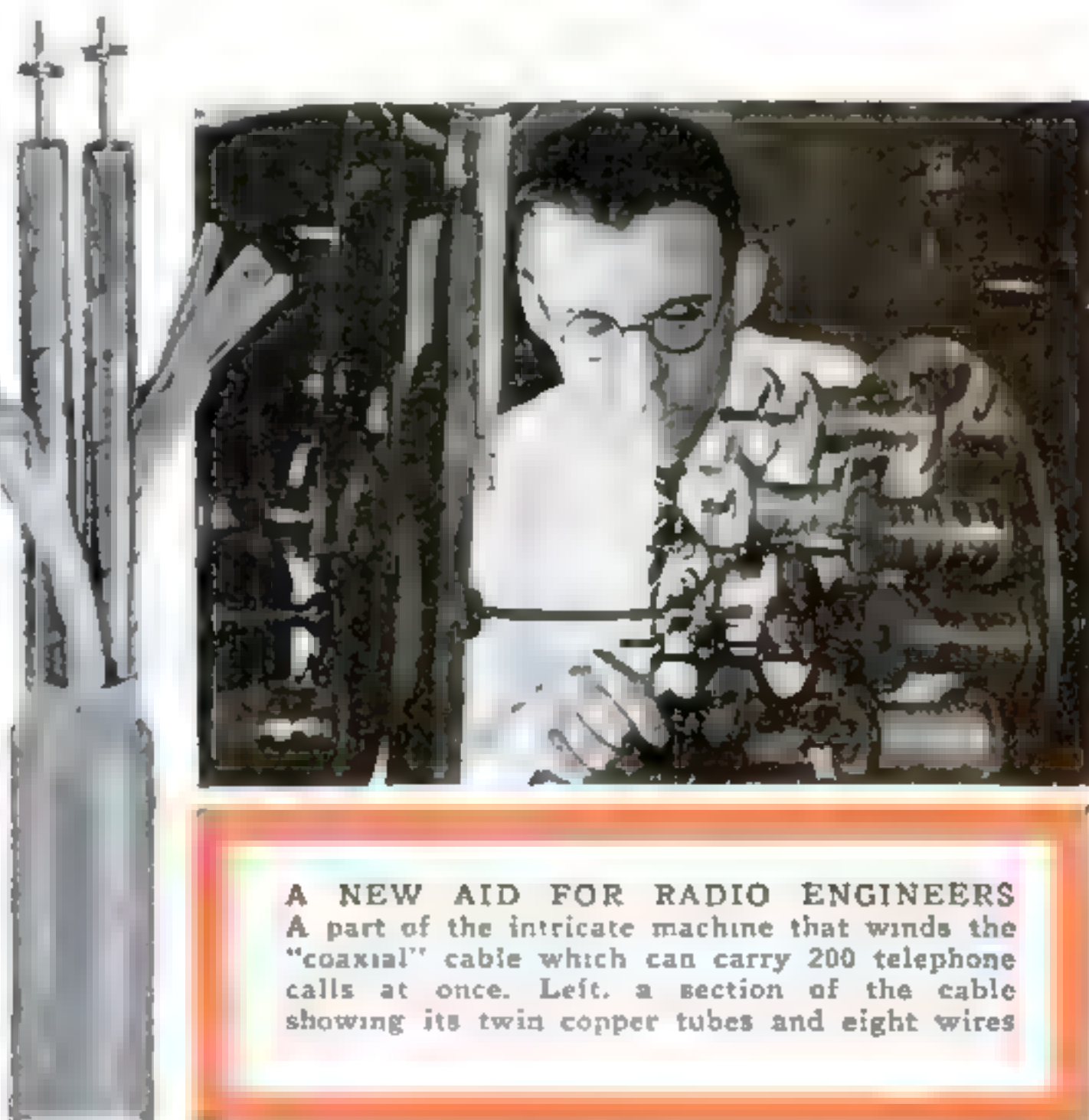
**T**HE problems connected with television, as you know, are far more complicated than those involved in the transmission of facsimile, or still pictures. In television, the image not only must be broken up into about 70,000 fragments, or elements, but it must be put together at least twenty times a second to fool the eye into seeing continuous motion. Twenty times 70,000 (*Continued on page 99*)



THE RADIO STATION COMES TO THE SPEAKER

Used on the floor of the Democratic convention at Philadelphia, this portable radio transmitter picked up speeches which were rebroadcast from a larger station

Philo Farnsworth, television expert, watching an image on the cathode tube of a receiving set



A NEW AID FOR RADIO ENGINEERS  
A part of the intricate machine that winds the "coaxial" cable which can carry 200 telephone calls at once. Left, a section of the cable showing its twin copper tubes and eight wires

# Deadly Magnetic Rays Harnessed for WAR on CANCER

By Alden P. Armagnac



Prof. George Pegram, of Columbia University, with apparatus used in measuring "neutrons," atomic particles only a ten-trillionth of an inch in diameter

**G**REENISH-BLUE in color, as weirdly beautiful as it is dangerous, a mysterious luminous ray nearly a foot in length streams at the touch of a switch from America's largest electromagnet. Scientists of the University of California watch it from a safe distance and thrill at the sight of the most powerful beam of radiation ever produced by man.

A finger placed in this ray for only an instant would be lost. Even approaching within twenty-five paces is perilous. White rats exposed to the lethal beam have quickly perished, their body tissue broken down and the white corpuscles of their blood destroyed. Here, it would seem, is the nearest thing science has ever produced to a "death ray" that can be projected through the air on a mission of destruction. Yet its creators hope, when they have learned to control its terrific power, to turn it into a veritable ray of life.

New hope for cancer sufferers comes from recent experiments with the ray. All the radium in the world, gathered together, could not begin to equal its curative power. The radiation from the University of California machine is equivalent to that of \$4,000,000,000 worth of the costly element—many times more than has ever been mined! Furthermore, preliminary experiments with mice encourage the belief that the new type

An "electric gun" built at the University of Wisconsin. In a steel tank filled with air at high pressure, a generator piles up high voltage that produces streams of atomic "bullets" of extremely high power. This radiation may prove effective in treating cancerous tissue

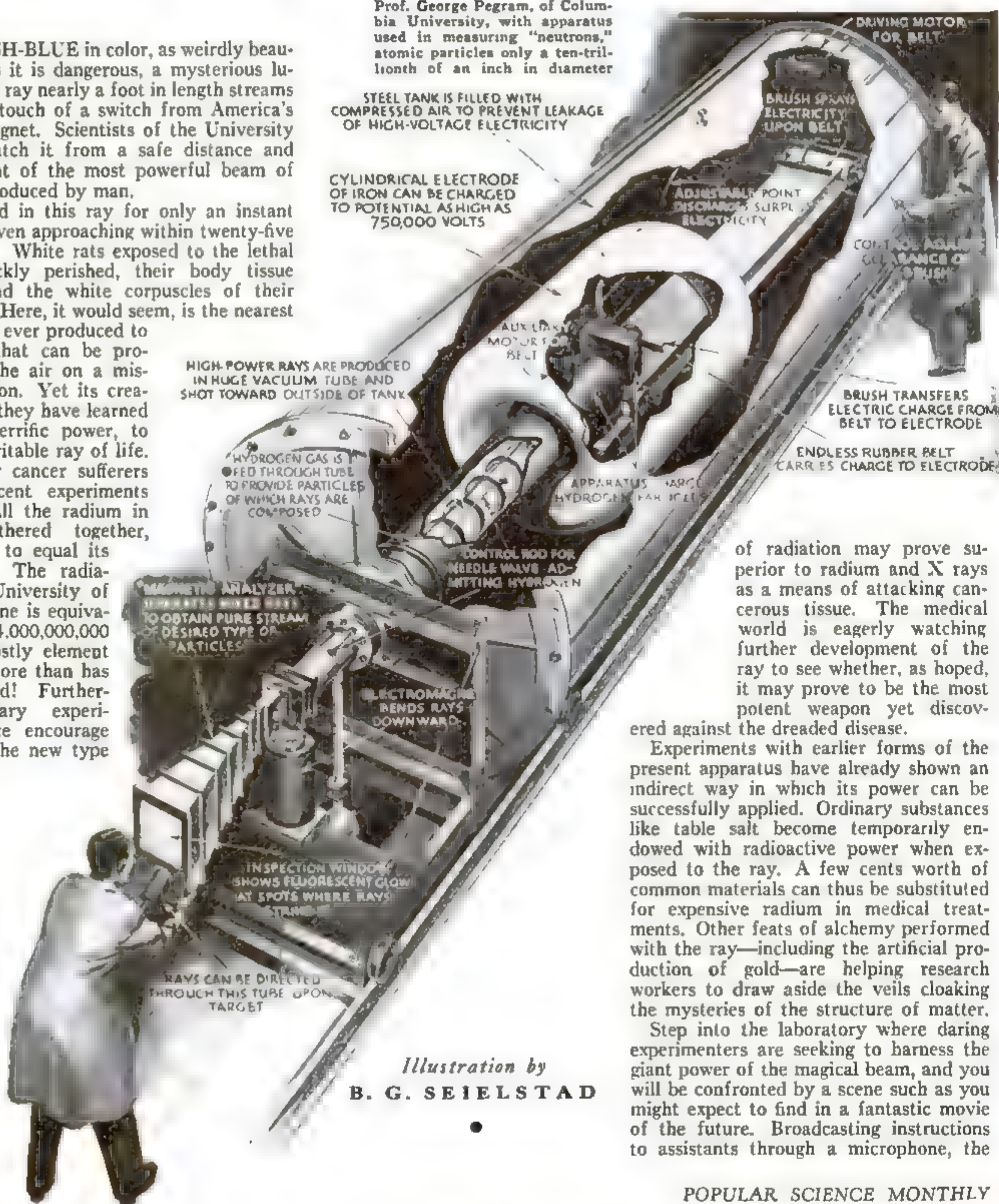
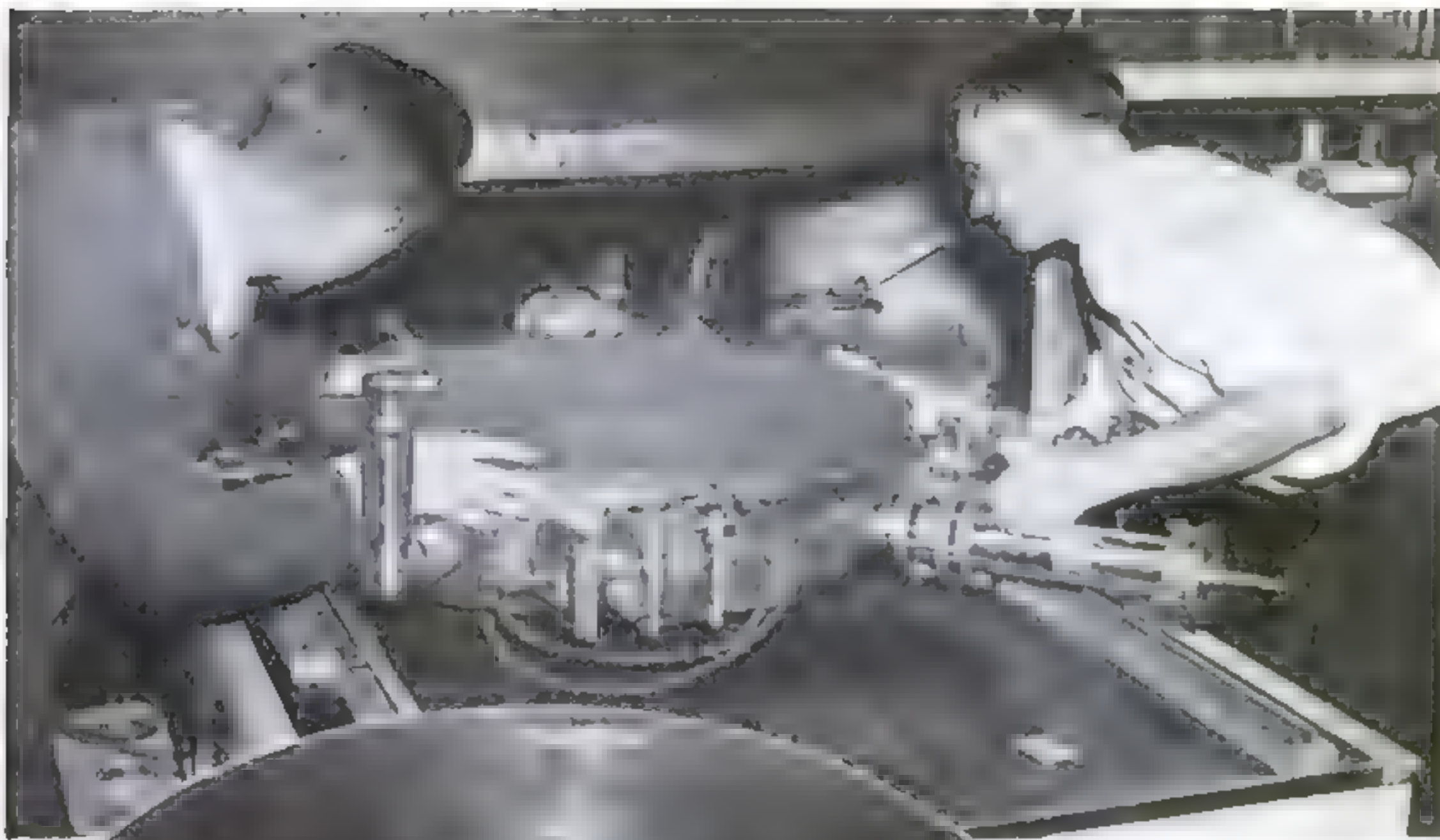


Illustration by  
B. G. SEIELSTAD

of radiation may prove superior to radium and X rays as a means of attacking cancerous tissue. The medical world is eagerly watching further development of the ray to see whether, as hoped, it may prove to be the most potent weapon yet discovered against the dreaded disease.

Experiments with earlier forms of the present apparatus have already shown an indirect way in which its power can be successfully applied. Ordinary substances like table salt become temporarily endowed with radioactive power when exposed to the ray. A few cents worth of common materials can thus be substituted for expensive radium in medical treatments. Other feats of alchemy performed with the ray—including the artificial production of gold—are helping research workers to draw aside the veils cloaking the mysteries of the structure of matter.

Step into the laboratory where daring experimenters are seeking to harness the giant power of the magical beam, and you will be confronted by a scene such as you might expect to find in a fantastic movie of the future. Broadcasting instructions to assistants through a microphone, the



Research workers placing a new bombardment chamber in the cyclotron, or magnetic gun, at the University of California. Inside this circular chamber the positively charged cores of atoms are whirled at a speed of 12,000 miles a second. Below weighing a mouse that has had ray treatment for a tumor



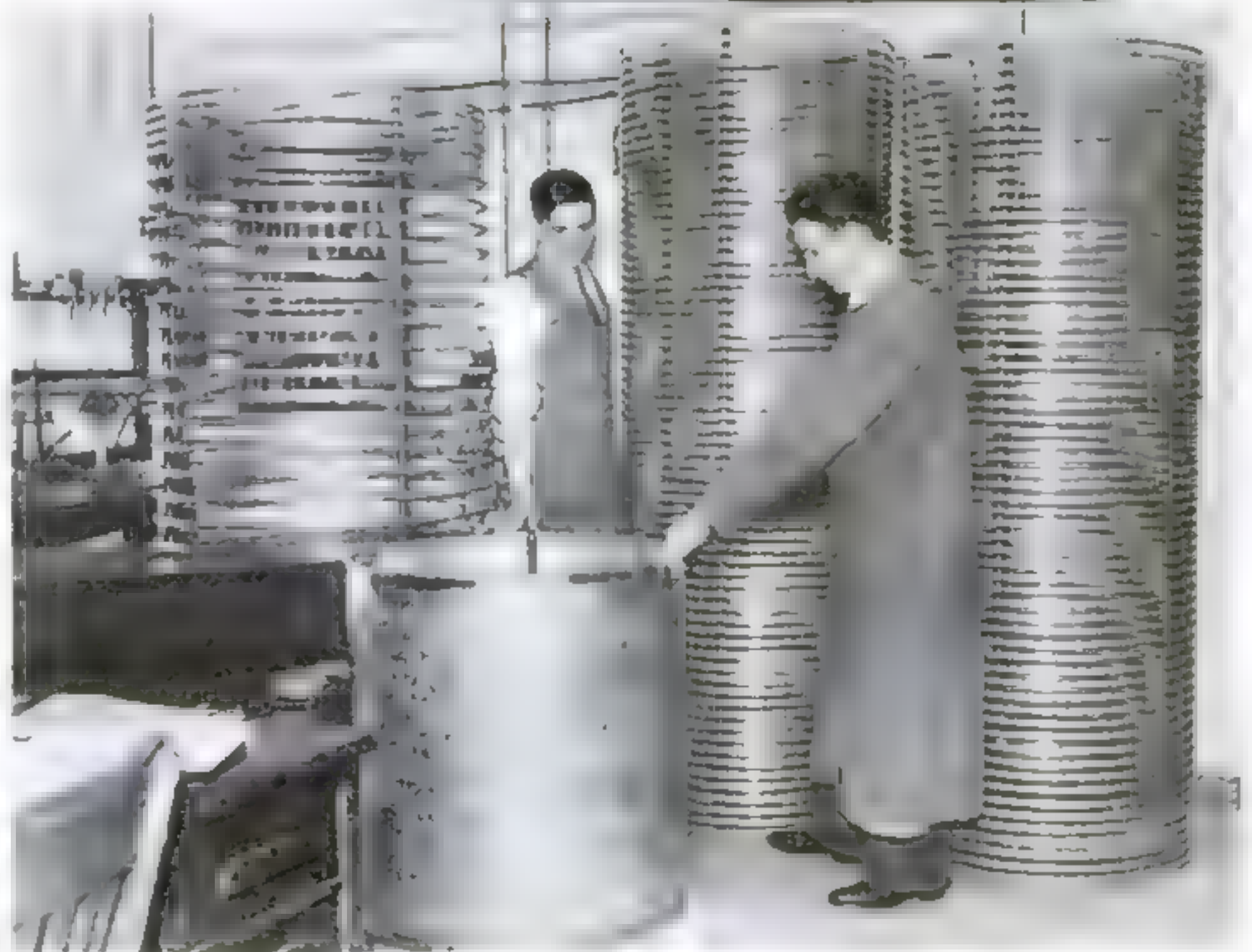
The most powerful beam of radiation man has ever produced—the luminous ray of atomic particles streaming from the cyclotron chamber



"ray pilot" sits before a remote-control panel fifty feet from the huge magnet. At his hand, a high-voltage switch turns the ray on or off. Tanks of water three feet thick help to barricade him from its deadly radiation. A spot of light the size of a quarter, moving across a ground-glass scale, shows him the power he is feeding to the beam.

Across the laboratory stands the magnet itself—an eighty-five-ton monster of iron and copper, resembling a pair of giant millstones poised one above the other. A circular vacuum chamber of metal, resembling an overgrown pill box, rests between the massive coils. The ray streams from this pill box, like a flaming plume of gas from an open jet.

What is this strange ray? It is neither an electric spark nor a beam of light. A closer guess, but still a wrong one, would be a beam of negatively charged particles, like the cathode ray in a television tube. Actually, it is a speeding stream of positively charged particles, or atoms minus their electrons, like miniature luminous beams that scientists have observed for fifty years in vacuum tubes and have named "positive" or "canal" rays. Until recently, no way was known to render these rays powerful enough for any practical use, and they seemed destined to remain laboratory curiosities. Now, Prof. Ernest O. Lawrence of the University of California has devised a machine that turns the underrated "positive" rays into one of science's most powerful tools, offering research workers as thrilling



D. B. Parkinson, at left, and Dr. R. G. Herb, of the physics department of the University of Wisconsin, with some of the equipment developed at that school for experiments in smashing atoms

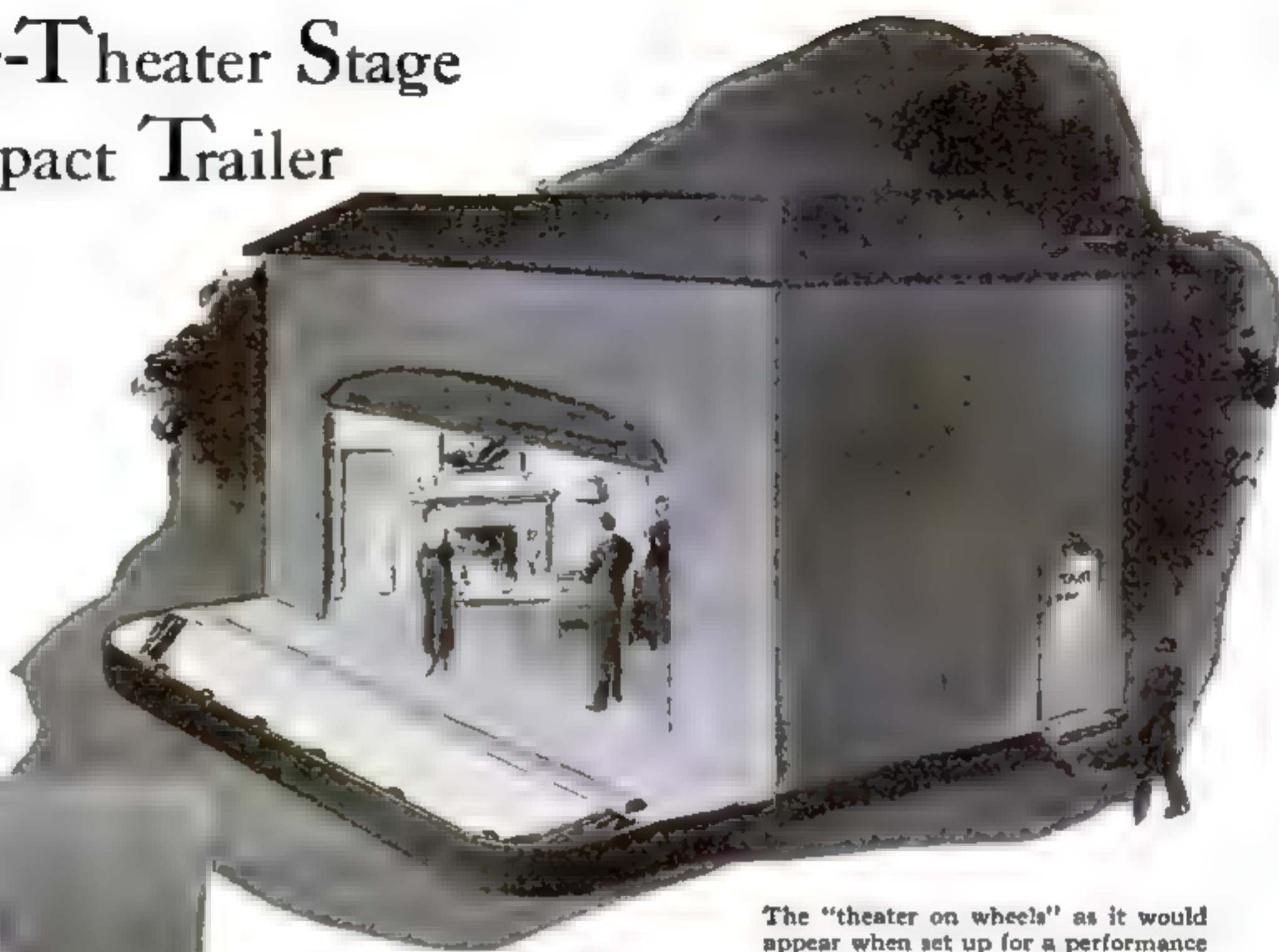
adventures as followed the invention of the X-ray tube and the discovery of radium!

His "cyclotron" or magnetic-ray gun—the magnet-and-pill-box combination—whirls atomic particles like a sling and then hurls them at a target in a beam of

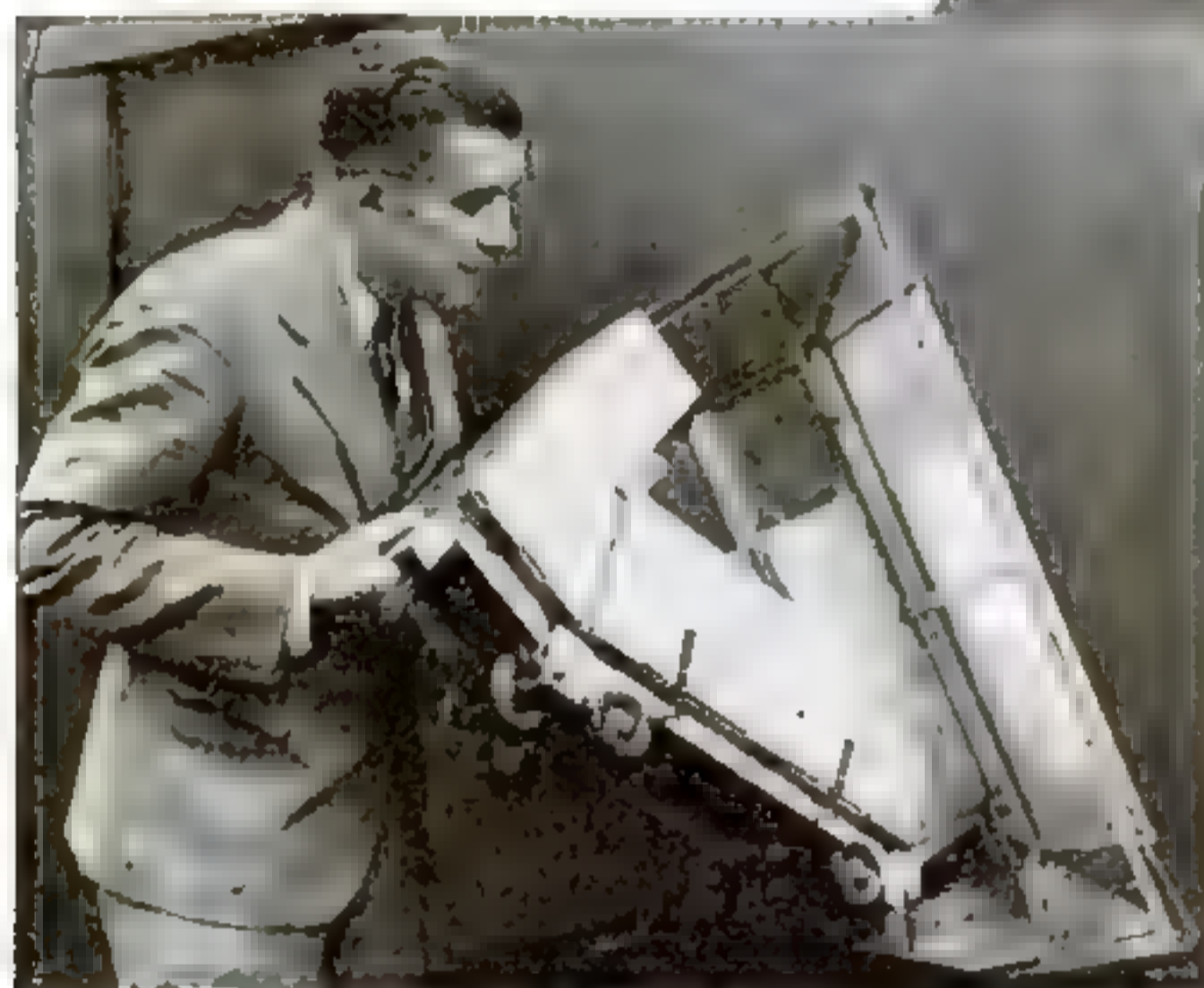
devastating power. For ammunition, he feeds into the center of the pill box the positively charged cores of atoms of hydrogen, of its newly discovered twin, "heavy hydrogen," or of helium, which he obtains by electrifying the respective gases. The (Continued on page 107)

# Collapsible Outdoor-Theater Stage Folds Into Compact Trailer

**P**LAYS may literally be taken "on the road" with a novel combination trailer and collapsible stage proposed by a New York inventor. Although plans call for a trailer body only eight feet long, the unit can be unfolded at an outdoor theater location into a stage about fourteen times the trailer size. The operation requires only twenty-five minutes. Ingeniously constructed of hinged and folding parts, the portable stage is opened and closed by a gear mechanism operated by two men. Locking, bolting, and bracing of the hinged units is said to make the stage weather-proof and substantial.



The "theater on wheels" as it would appear when set up for a performance



The inventor manipulating an electrically operated model to show how the gear mechanism folds the stage into a trailer

## COOPS KEEP WORKERS COOL

**AIR-CONDITIONED** cubicles, recently introduced to keep office workers comfortable on torrid summer days, inclose each occupant in an individual glass compartment open at the top. Chilled air from a standard conditioner, being heavier than the warmer surrounding air, flows downward into the inclosure and fills it up as water fills a bathtub. The interior of the cubicle may thus be kept as much as twenty degrees cooler than the exterior. Its limited space, a cube measuring six feet on a side, makes the process economical



An office worker, inside a glass "tank," regulating the air conditioning unit that keeps the cubicle filled with chilled air

## SKETCHES FLIES FOR HEREDITY STUDY

**DRAWING "portraits"** of flies is the unique vocation of Miss Edith M. Wallace, California scientist. In her laboratory, Miss Wallace peers into a microscope and traces enlarged drawings of vinegar flies to aid in the study of heredity laws. Since important details of a fly's appearance can be emphasized in sketches, the latter are preferred to photos. The vinegar fly was selected for the study because its life cycle is extremely short, thirty or more generations being produced in a year.



Left, Miss Edith M. Wallace sketching a fly from life. Above, the collection of flies at the laboratory

## ALL-PURPOSE ILLUMINATED SCREW DRIVER

**FOLLOWING** the introduction of illuminated screw drivers for special purposes, an all-around tool of similar design has just been placed on the market. A built-in flash-light bulb beside the shank of the blade throws a concentrated beam of light to aid in working in a dark place, when a switch in the handle is thrown. The hollow interior of the handle contains the flash-light cells.



A flash-light bulb beside the shank of the blade of this screw driver lights up the dark corners



### MAMMOTH LOUDSPEAKERS ANNOUNCE AUTO RACES

GIANT sound projectors resembling high-powered searchlights, clustered on a tower in the center of a new auto-racing track at Mineola, N. Y., broadcast announcements of events over an area of half a square mile. The huge loudspeakers will radiate sound evenly to the far corners of the track, while smaller projectors on the same tower will serve near-by spectators to insure uniform sound intensity. The photographs show one of the big speakers and a smaller one set up on the roof of a building for tests.



### ELECTRIC CURRENT RELIEVES HAY-FEVER SUFFERERS

ELECTRICITY is an effective weapon against hay fever and asthma, according to Dr. Harold L. Warwick, of Fort Worth, Tex. In a treatment that he has devised for chronic sufferers, the nasal passages are anesthetized and packed with cotton saturated in a chemical solution. A slender positive electrode is then inserted in the cotton, while a negative electrode is attached to the patient's wrist. A feeble electric current is supplied to the electrodes for a period of about ten minutes. The current coats the mucous membranes of the nasal passages with a substance that is said to desensitize them to plant pollen and other irritants.

### FISHLINE MADE OF SPUN GLASS

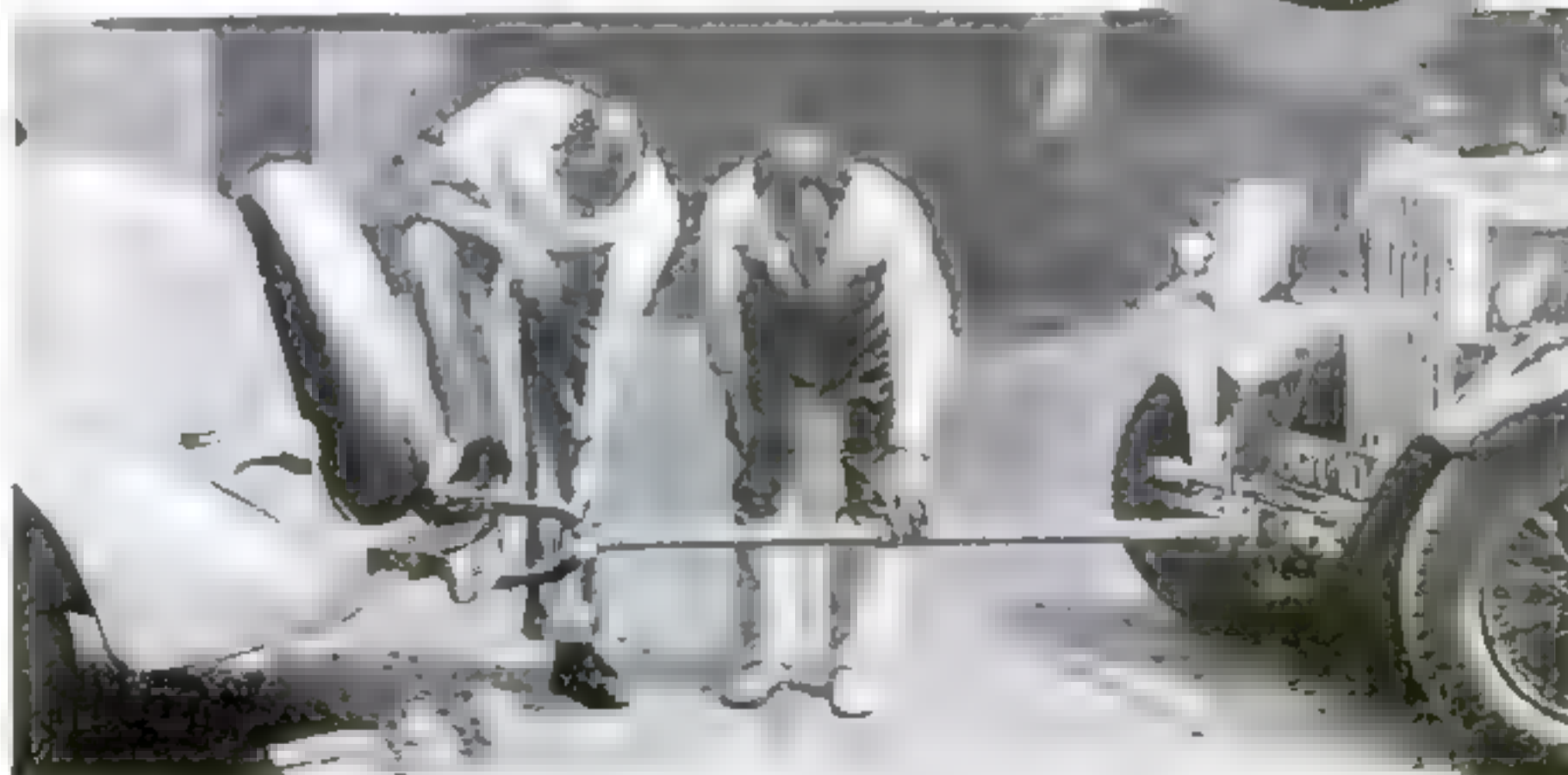
SPUN GLASS forms the novel material for a fishline now being tested and perfected. In recent laboratory experiments on various tackle materials, the glass line withstood a pull of thirty-seven pounds, while silk line of the same size broke at eighteen pounds, and linen at twenty-eight pounds. In addition to its strength, the glass line is said to be exceptionally resistant to the attack of molds and fungi in the water.



A three-pound salmon and an eighty-pound boy hanging on a bar supported by fishline of a new type made of spun glass

### STEEL CLAWS CATCH BANDIT CARS

To aid in catching criminals in automobiles, Sir Malcolm Campbell, famous English racing driver, has devised a "claw-arm" attachment for the front of a police car. Operated from the driving seat, a telescopic metal column bearing a pair of strong steel claws can be extended nearly six feet in front of the police auto. When officers overtake a speeding bandit car, the arm is extended until a small circular buffer contacts the rear bumper, causing the open jaws to snap closed. The police car then applies its brakes and drags the trapped auto to a stop.

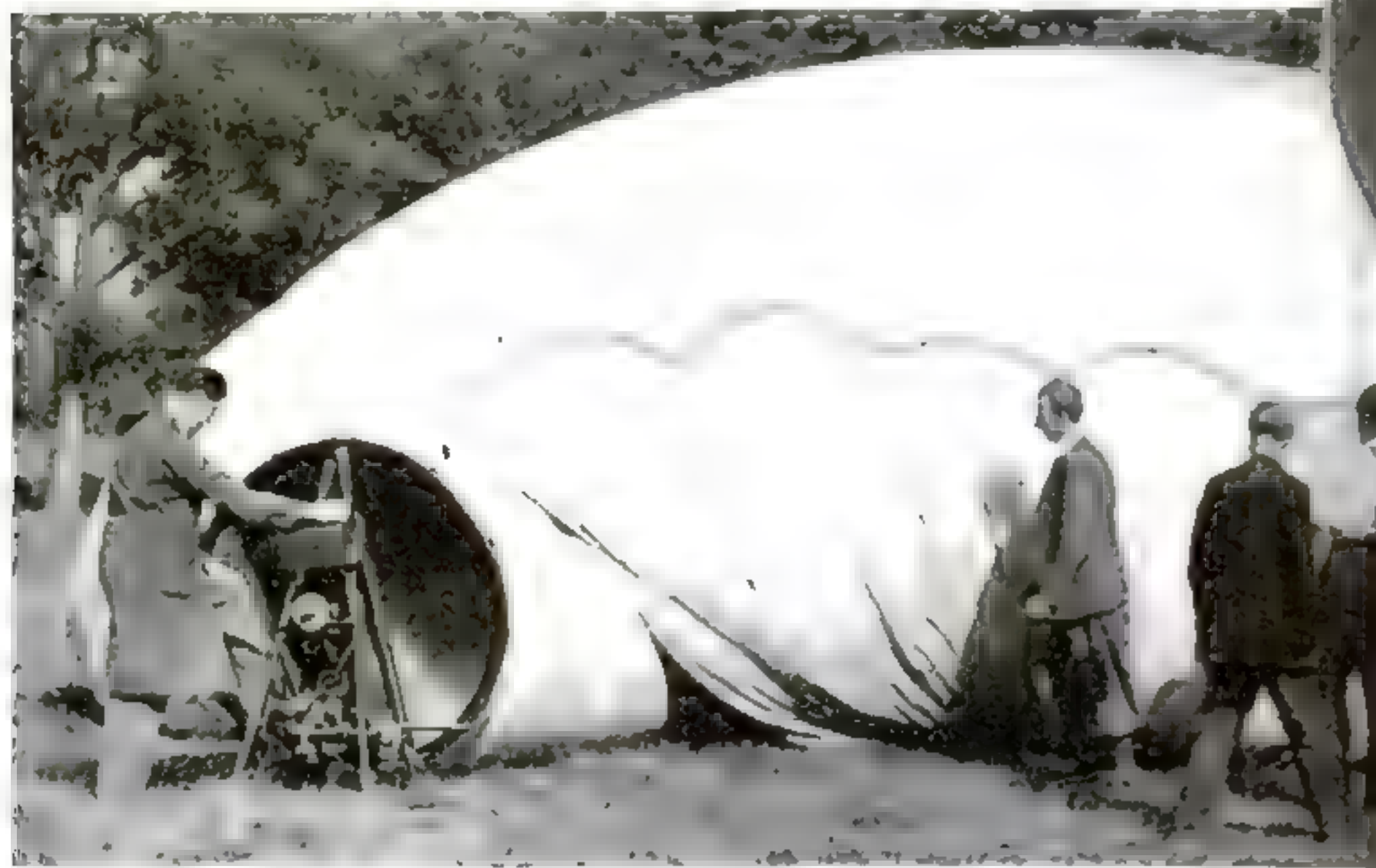


Mounted on the front of a police car, this telescopic metal column can be extended to grip the rear of a speeding bandit auto. Oval shows a close-up of the claws and buffer contact

## FAN BLOWER FILLS HOT-AIR BALLOON

HOT-AIR BALLOONS, almost obsolete since the advent of lighter-than-air craft filled with hydrogen or helium gas, have been modernized by two Austrian inventors. A motor-driven blower distends the bag of their balloon with air before the take-off,

and a kerosene torch supplies heat to provide the necessary lifting power. By regulating the supply of fuel to the burner, the craft may be made to rise or descend at will during extended flights.



At the left, the balloon is being filled with air by means of a blower. Above, it is seen in flight with a kerosene torch alight to provide the necessary buoyancy



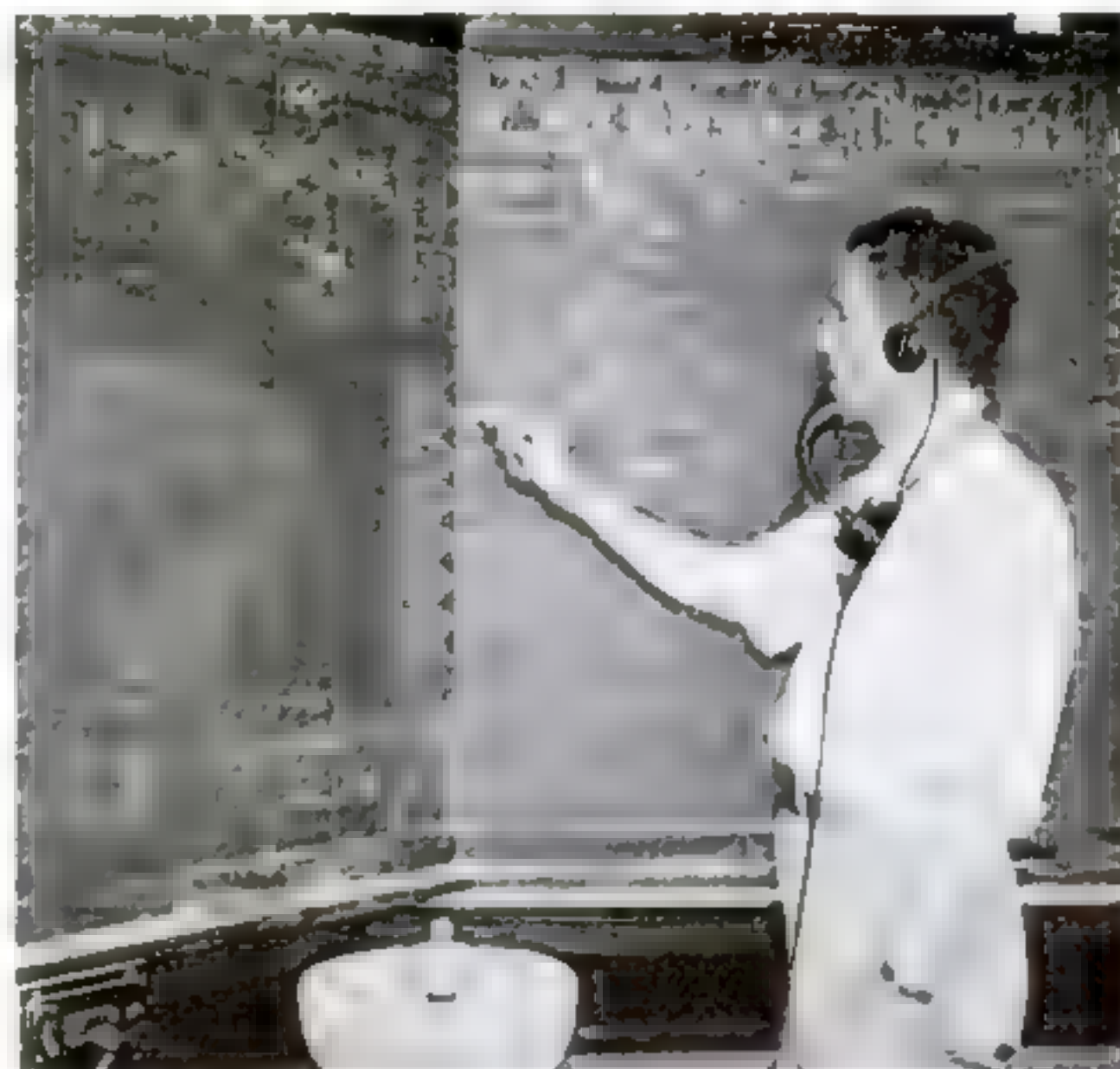
Swivel head of tripod and, right, the camera suspended below

### TRIPOD HOLDS CAMERA IN ANY POSITION

MOUNTED on the aluminum-alloy head of a new photographic tripod, a camera can be swiveled in any direction and securely locked in position. For taking pictures from close to the ground, the central supporting column can be reversed so that the camera hangs downward as shown.

## "BLIND" FLYERS GET TRAFFIC CONTROL

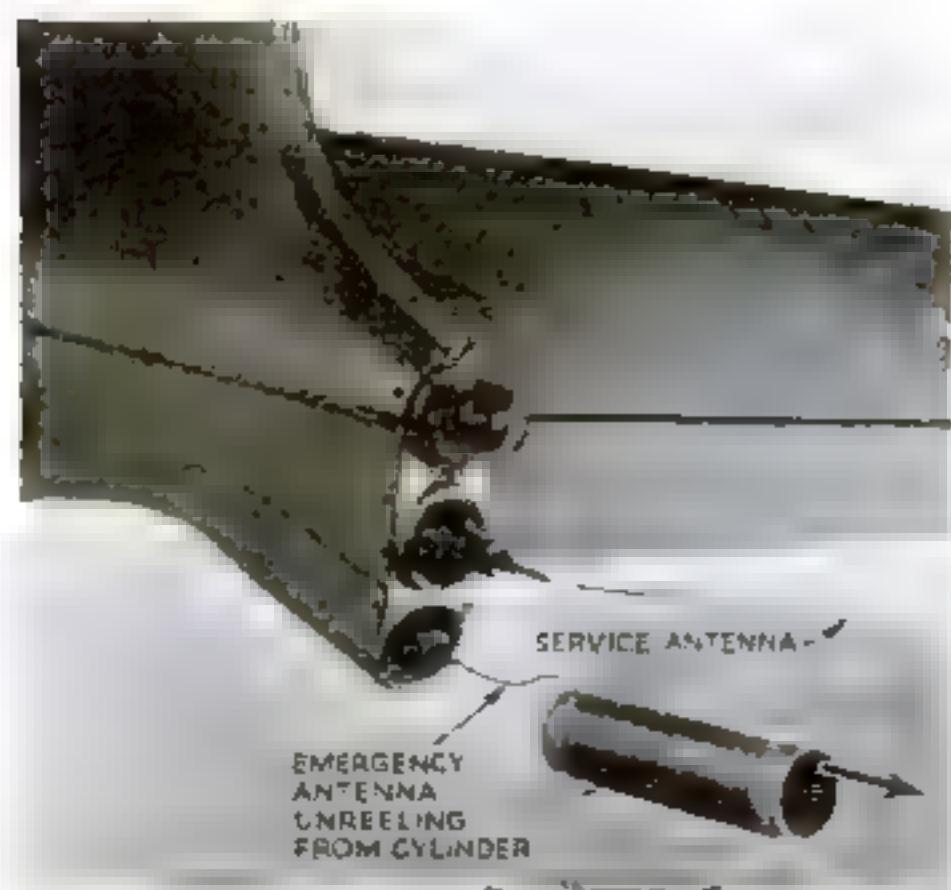
COLLISIONS between planes flying "blind" along the same airway will be averted through a new system of aerial traffic control. U. S. Bureau of Air Commerce control crews, cooperating with air-line operators, will take over the responsibility of dispatching all craft on heavily traveled routes. Pilots will be given ample headway and will fly at prearranged altitudes, while the "controllers" follow their progress by radio reports. If one plane is found to be overtaking another in the fog, at the same level, it will be redirected by radio to a different altitude so that it will clear the other ship by a safe margin, although the pilots cannot see.



A U. S. Bureau of Air Commerce dispatcher routing airplanes by radio to prevent collisions while "blind-flying" through a fog

### CARTRIDGE RELEASES EXTRA PLANE ANTENNA

SHOT OUT of the tail of an airplane, an auxiliary radio antenna just perfected will be used in emergencies to supplement the standard trailing antenna. Housed in a metal casing just below the regular aerial, the catapulting mechanism consists of a compression spring and a release trigger operated from the cockpit. When a switch is thrown, the spring apparatus ejects a cardboard cylinder on which is wound the auxiliary antenna wire. The latter unrolls into a conventional trailing antenna and the empty cardboard coil drops to the ground.



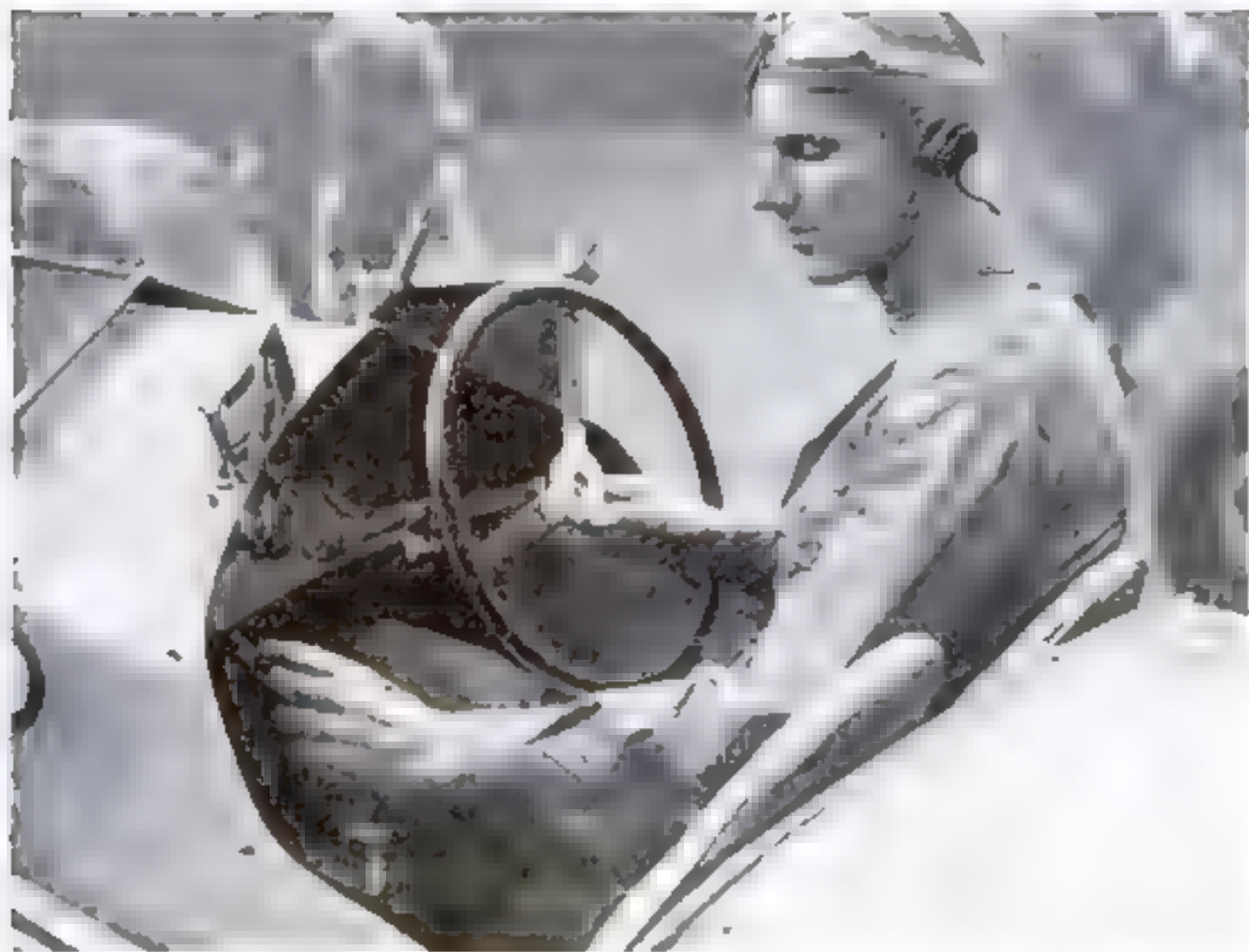
Discharged from the tail of a plane in flight, this cartridge unrolls an auxiliary radio antenna



### PEST YIELDS VITAMINS

MEDICINAL oil eight times as potent in vitamins as cod-liver oil is being extracted from the liver of the burbot, a fish long considered a pest in northern Minnesota lakes because it devoured the young of other species and threatened to ruin commercial and game fishing. Above is shown a specimen, its liver, and the oil extracted from it.

## RACING DRIVER GETS INSTRUCTIONS THROUGH SHORT-WAVE RADIO SET



Headphones fitted to his helmet enable this British racing driver to receive instructions from the transmitting truck pictured at the right



**S**PEEDING over the track, the driver of a radio-equipped car in a recent English speed event was given instructions, advice, and the position of other entrants from a short-wave transmitter installed in a truck parked at the side of the course. Special headphones were fitted into the driver's crash-proof helmet to enable him to hear the messages above the roar of his motor. This is believed to be the first time that a racing car has ever received its instructions by radio rather than by signal flags waved by helpers in the racing pits at the side of the track.

## SPONGE-RUBBER CURTAINS MUFFLE OUTDOOR NOISES

CURTAINS made of sponge rubber have recently been marketed to muffle outdoor noises transmitted through the panes of a closed window. Provided with eyelets so that they may be hung from nails or hooks at the window top, the sound-absorbing material is also said to subdue interior noises ordinarily reflected by the window pane. The curtains can be used with an open window if the latter is fitted with a motor ventilator of the silencing type.



Curtain hung over window to deaden outside noise

## COAST AREAS SHOW FEW DEATHS FROM LIGHTNING

STATES of the Pacific and North Atlantic coasts record fewer fatalities from lightning than any other sections of the country, according to figures recently compiled by statisticians of a prominent life-insurance company.

## WORLD'S BIGGEST HALF-TONE SCREEN

MEASURING fifty-eight inches in diameter, the circular half-tone screen illustrated at the left and two others of equal size are called the biggest of their kind in existence by their Philadelphia, Pa., makers. The monster disk is shown attached to one of the largest color cameras ever built, for use in making photographic half-tone negatives for large lithographic reproductions. Its function is to break up a picture into a pattern of dots, exactly in the manner of the homemade half-tone screen described on page 76 of this issue, so that the picture when printed will show gradations of shade from high lights to shadows. To make the record-sized screen, two separate sheets of glass were ruled with parallel lines, spaced 120 to the inch, and then sealed together with the lines at right angles to each other.



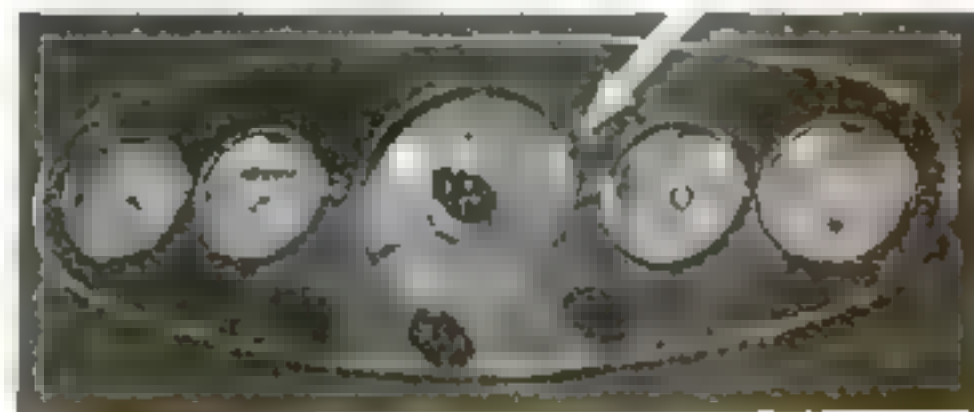
Fifty-eight-inch half-tone screen for making lithographs

## HUMANE ANIMAL TRAP HAS NO SHARP JAWS

SHARP steel jaws of the conventional animal trap are replaced by a strong chain loop in a humane but effective "snare-trap" invented by a zoologist of the U. S. Biological Survey. Two chains, each of which is threaded through a ring in the other, are stretched tightly between the ends of a strong spring-wire arch. To set the trap, the chains are spread and held

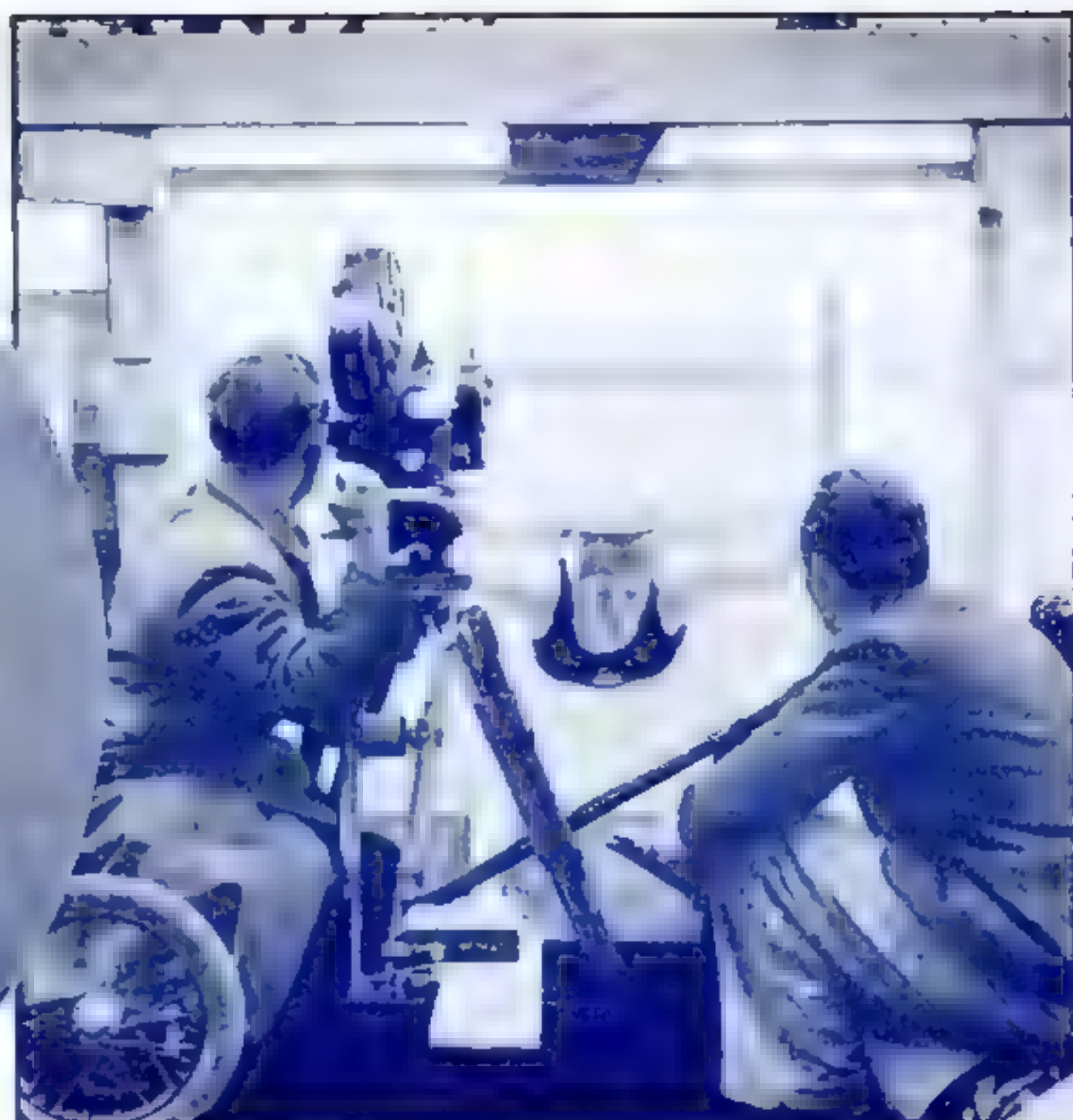


apart by a four-legged metal "spider," to which is attached the bait or lure. When an animal steps into the loop, the spider collapses, causing the spring arch to snap the chain loop upward and pull it into a close-fitting noose around the animal's leg.



## NOVEL AUTO INSTRUMENT SHOWS AVERAGE SPEED

COMBINING the functions of a mileage meter and a clock, a new dashboard instrument for cars, devised by a German inventor and called a "tempometer," shows a driver at a glance his average speed during a trip. As every motorist knows, this is often a very different figure from the speedometer pace he has tried to maintain. The new instrument is intended to help him estimate the daily distance he can cover on a long tour, and the speed at which he must drive to arrive at his destination on time.



A cameraman making motion pictures of an expert swimmer in action, through the glass wall of a tank. The film, a "still" from which is shown at the left, shows the correct method of making various strokes



# Queer Machines

**I**N THE "old swimming hole" of today, strange mechanical aids are teaching scientific strokes and are clipping days from the time required for beginners to learn. Instead of being shoved into the water, tyros of 1936 begin their training on dry land and perfect their technique before they go near a pool.

With millions of people flocking to beaches on hot days, swimming takes front rank as an outdoor sport in summer. Prob-

ably more people now go swimming in the United States than ever went before. Fast automobiles and good highways have brought beaches and pools within reach of millions who lacked the facilities for aquatic sports in the days of the horse and buggy. So, it is only natural that science should be turning its attention to this national summer pastime.

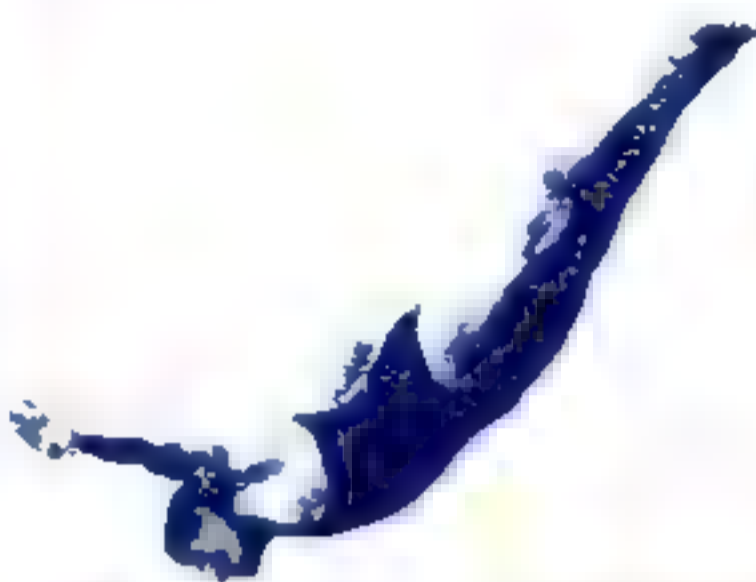
The new methods of training not only make better swimmers but they save lives



The floats on this elaborate device keep a swimming novice afloat, while hand cranks turn the propeller to provide locomotion

In the aquatic pacemaker shown at the right, a moving cable carries a flag across the pool above the swimmer's head to set the desired speed





Diving without water is made possible by the apparatus at the left, which is used by a college swimming coach. The student leaps off a springboard and is guided by a rope attached to a safety belt, to learn dives like those above

# Train Swimmers

by increasing the number of people who can keep afloat in an emergency. The practical courses they give a beginner are worth acres of textbooks. And, they are giving the advanced swimmer special aid that will help make champions.

Underwater movies, now available, show the technique of experts actually swimming. Students can study and analyze their movements and learn how to handle themselves to best advantage. Diving helmets, also enable beginners to descend to the bottom of a pool and study the strokes of an instructor from a fish's-eye viewpoint.

As the student advances in skill, new scientific aids carry him through the more difficult steps of the art. Aquatic counterparts of the mechanical rabbits which pace racing greyhounds are provided at one pool for training speed swimmers. Instead of

depending upon guesswork, the racers develop a judgment of pace by following a small flag towed at a given speed down the pool.

Even experts take advantage of the latest aids which science has to offer. When the American swimming team sailed for the Olympic games, a few weeks ago, their ship carried on deck a special tank in which the stars could keep in form. A line and harness held them back while they practiced their speed-swimming movements.



Wearing this improvised diving helmet, a learner can go under the water for a fish-eye view of the instructor as he demonstrates arm and leg movements

Proper coordination of arms and legs is taught by the odd machine at the left. As the hands move cranks that simulate arm strokes, extension rods impart the corresponding movements to the legs, which rest on platforms

Salo Finkelstein, famous memory expert, repeating a square of twenty-five numerals that he had memorized in less than nine seconds. He could recall the numbers in any order requested



# Memory Experts MADE TO ORDER



Psychologists at Ohio State University testing the "fast-scor," a machine that gauges the speed with which a subject reads or memorizes a series of numerals or other matter

man mathematician. Before Finkelstein ended his visit with the psychologists, however, he had accomplished the unprecedented feat of committing a twenty-five-number square to memory in less than nine seconds.

The experimenters had taken a man who was already a number expert and had made him into a world's-record breaker. Could they improve an ordinary person's memory for figures proportionately? With college students as material, they tried making number geniuses to order. "H. W.," one of their subjects, received seventy-five hours of special training—and proceeded to astonish even his instructors.

How long would it take you to learn by heart the number 624706845986193261832? Dr. Finkelstein did it in 4.43 seconds—considerably less time than you would need to read the number aloud. But "H. W." managed the same feat in only 4.37 seconds, beating the most rapid memorizer known to science!

Hardly less spectacular were the performances of other college students given the same training. The experiments thoroughly demolished the old-fashioned idea that the victim of a mediocre memory is just born that way and that there is nothing he can do about it.

Modern psychologists agree that almost all of us, in fact, can learn to perform memory feats far beyond any of which we dream ourselves capable. The average person forgets names and faces, facts and figures, simply because he never really has to remember them. Lack of incentive is to blame. Admire, if you like, the amazing

**C**AN the average person become a memory expert? Psychologists of Ohio State University are providing a spectacular answer. They are turning run-of-the-mill college students into "lightning calculators" like the number wizards who entertain you from the stage.

What inspired the unique experiment was a visit from Dr. Salo Finkelstein, Polish mathematical performer, who was hired by an American broadcasting company to tally returns of the 1932 presidential election because he was faster than an adding machine. His stay at Ohio State lengthened to a year and a half, while research workers subjected him to a number of tests. One of their objects was to discover the secret of his prodigious memory for numbers. Another was to see whether they could train him to improve his own

performance. They succeeded in both attempts.

Imagine memorizing twenty-five numerals arranged in rows and columns of a square—and doing it so well that you can repeat them vertically, horizontally, or in any order called for. When Dr. Finkelstein arrived at the university, he could accomplish this in seventeen and a half seconds. The world's record of a shade under thirteen seconds was held by a Ger-

*Amazing Feats of "Number Wizards" Matched  
By Average College Students After Training  
In an Intensive Seventy-Five-Hour Course*

By JOHN E. LODGE

memory of the actor for his lines; of the hotel check-room attendant who needs no check to hand you the right hat; and of the "walking encyclopedias" in public information booths—but remember that they earn a living that way. You would surprise yourself by your own powers of recollection if your bread and butter depended upon it.

Edgar J. Smith, Washington University psychologist, tells of a milk-wagon driver who deliberately set out to turn an unskilled job into a skilled one by improving his memory for names and addresses. His ambition won him a position as substitute driver for ten different routes of 300 addresses each, at double his former pay. When one of the regular drivers was sick, the substitute took his place. Though he carried no written records, he knew by heart the names and addresses of the 3,000 customers, and whether to leave one quart or two at the home of each.

Other people are impelled to staggering feats of memory by their interest in a hobby, or simply for the sake of the achievement itself. A student of the Scriptures commits the Bible to heart, from cover to cover; a lover of classical literature memorizes the works of Homer. While the usefulness of such feats as these may be questioned, consider an unexpected practical use that Barthold Niebuhr, German historian, found for his remarkable powers of recollection. While he was employed as an accountant, in his youth, one of the account books was destroyed. Niebuhr replaced its entire contents from memory!

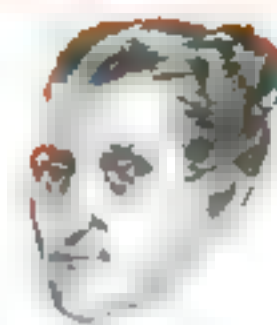
Suppose that you really want to improve your memory. How should you go about it? First, you must decide which kind of memory you are most interested in. "Memory," psychologists tell us, is a convenient collective *(Common Sense)* 115



MR. THOMPSON



MISS BENTLEY



MISS RICHARDSON



MR. BLAKELY



MR. COOPER



MRS. WINCHESTER



MR. GORMAN



MR. HART



MR. FLETCHER



MR. CALDWELL

#### A TEST FOR THE ASSOCIATION OF NAMES WITH FACES

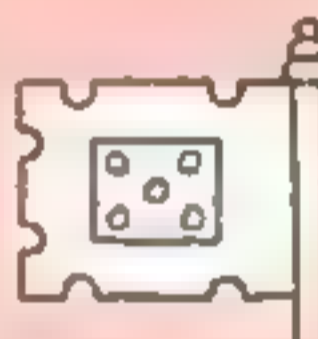
How good is your memory for names and faces? Study this picture carefully for three minutes; then turn to page 116 and see how many of the faces you can recognize and identify accurately by filling in the names to correspond with the numbered sketches

### Test Yourself...

Here are some tests for different kinds of memory, adapted from standard forms used by psychologists, that you will enjoy trying. By seeing which ones you do best at, you can judge what type of memory you have. If you make a good score on the auto-accident picture below, you have an eye for small details.

MON	BOY
TEK	CAT
RAB	RUG
LUZ	INK
DAL	ANT
BIK	BOX
NOOR	LAMP
PEEF	PIPE
LOUG	BEAR
WUT	FIG

**"VISUAL" MEMORY**  
Look at this picture of an old Spanish flag for fifteen seconds. Then try to reproduce it from memory



If you can memorize the nonsense syllables at the left, above as quickly as you can the words, at the right, you have a good memory for numbers and unrelated things



Examine this picture of an auto accident for fifteen seconds. Then see how many of the questions on page 116 you can answer

# Amateur Stargazers

HELP COMPLETE OUR PICTURE OF THE UNIVERSE

Charles W. Elmer, of Southold, N. Y., looking through the sight of his celestial camera. This amateur has taken some of the best star-field photos made outside a professional observatory

When we remember that most of the famous astronomers of history were really amateurs, this does not seem so strange. Sir William Herschel, perhaps the greatest of them all, built telescopes, discovered the planet Uranus and double stars, and studied the rotation of the planets, between sessions as a musical authority and professional organist in a church in Bath, England. The late Prof. E. E. Barnard, whose photographs of nebulae and of bright and dark clouds in the Milky Way are among the finest ever made, began his career by taking amateur photographs of comets. Dr. George Ellery Hale, dean of American astronomers, was a noted amateur before he helped found the Mt. Wilson Observatory, now one of the most famous in the world.

As an example of amateur aid to science, we have only to recall that all the brilliant new stars, or novæ, of the present century have been discovered by amateurs. The Rev. T. D. Anderson, a clergyman of Edinburgh, Scotland, was the discoverer of Nova Aurigæ, in 1892, and of Nova Persei, in 1901. A South African amateur, Richard Watson, was the first to detect the outburst of Nova Aquilæ, in 1918, a bright new star that was discovered independently by more than a dozen ama-

**F**ROM a crude back-yard observatory near Delphos, Ohio, one night a few weeks ago, Leslie C. Peltier, draftsman by day and amateur astronomer by night, slowly swept the northern sky with his stubby six-inch telescope. The twinkling lights that paraded before him as he swung through the constellations Ursa Minor, Draco, Camelopard, and Cassiopeia were all old friends of years of observation.

In Cepheus, however, young Peltier spotted a fuzzy object that started thrills running down his spine. Whatever it was, it was recorded in no chart or atlas. For five hours he watched, noting during that time that the object was shifting slightly. Finally, convinced that he had discovered a comet, he telegraphed to Harvard Observatory. A big telescope there was rushed into action. In a few minutes, congratulations flashed back to Delphos. Once more an amateur had captured the honor of discovering the first comet of the year.

Shortly afterwards, on June 19, Peltier again made the headlines with the discovery of a nova, or exploding star.

Immediately, the eyes of the public

were turned once more on that great fraternity of advanced amateur astronomers, scattered all over the world, who were not only enjoying the wonders of a thrilling hobby, but coöperating regularly with professional astronomers in charting and studying the universe in which we live.

Sweeping the sky nightly with instruments ranging from field glasses and homemade six-inch reflecting telescopes to big refractors and reflectors that would do credit to any college observatory, these boys and men (and women, too!), numbering thousands in the United States alone, search for new stars and comets, chart the paths of meteors, measure the fluctuations of variable stars, and take amazing photographs and spectrographs of the sun, moon, stars, and planets.

Far from "amateurish," the results of much of this fascinating work are of such excellence that they are used constantly in university and professional work.

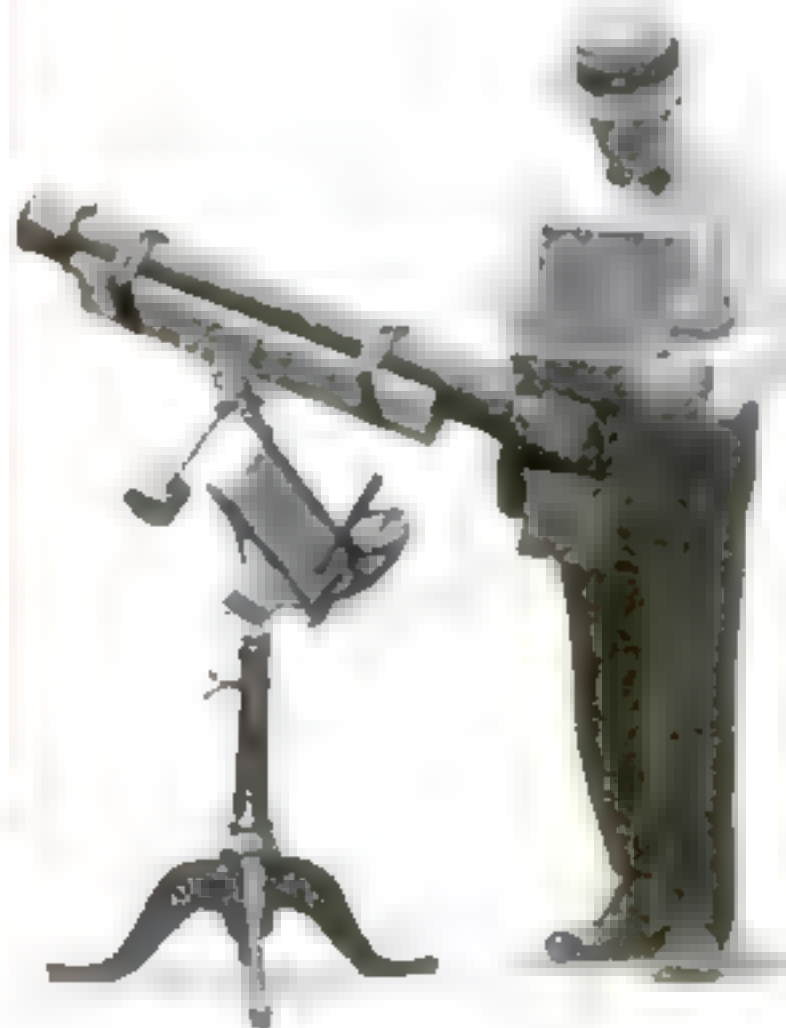


A photograph of the moon, taken with a 28½-inch reflecting telescope by Gustavus Wynne Cook, of Wynnewood, Pa. It shows the phase after the full moon



One of the remarkable sun-spot pictures made by William Henry, of Brooklyn, N. Y. He is seen at the right with the small telescope and reflex camera he used in "shooting the sun" from his own back yard

*Sweeping the sky with their telescopes, thousands of free-lance astronomers coöperate with the big observatories by watching for new stars and comets*



passed through more than 280 cycles, and, due to the diligence of the amateurs, not a single instance of maximum brightness has been missed. No professional astronomers could follow the caprices of such stars; yet it is believed by many authorities that a correct interpretation of their fluctuations—possible only through the accumulation of a tremendous amount of data—means the key to the riddle of stellar evolution.

Amateur estimates of the brilliancy of variable stars are made by visual comparison with constant stars of known brightness. All that is needed is a star atlas, a telescope having at least a three-inch aperture, and the standard

## By KENNETH M. SWEZEY

teur observers, Nova Herculis was spotted by at least four amateurs, from remotely different parts of the earth.

On its present popular and organized basis, amateur astronomy probably dates from the founding of the American Association of Variable-Star Observers, in 1911.

Reaching out from our local solar system, professional observatories were already grappling with the vaster and more complex mysteries of the stellar universe. Every big telescope available was being worked overtime in mapping the skies, photographing nebulae and star clusters, analyzing spectra, groping deeper and deeper into space. No men or instruments were left for such routine, though equally important, jobs as patrolling for new stars, comets, and meteors, and keeping an accurate check on the erratic fluctuations of brightness in some 500 long-period variable stars.

Here was a real chance for the serious amateur. Edward C. Pickering, then director of Harvard Observatory, suggested the matter to William Tyler Olcott, an attorney and amateur telescopist of Norwich, Conn. Olcott gathered together half a dozen other star lovers. The offshoot was the founding of an organization with the purpose of pooling and coördinating the work of amateurs for the benefit of science. Today, this organization has more than 300 members in twenty-three countries, and is responsible for more than half a million skilled observations. If compressed into a single work, the bare data of these observations would fill a book of more than 2,000 pages.

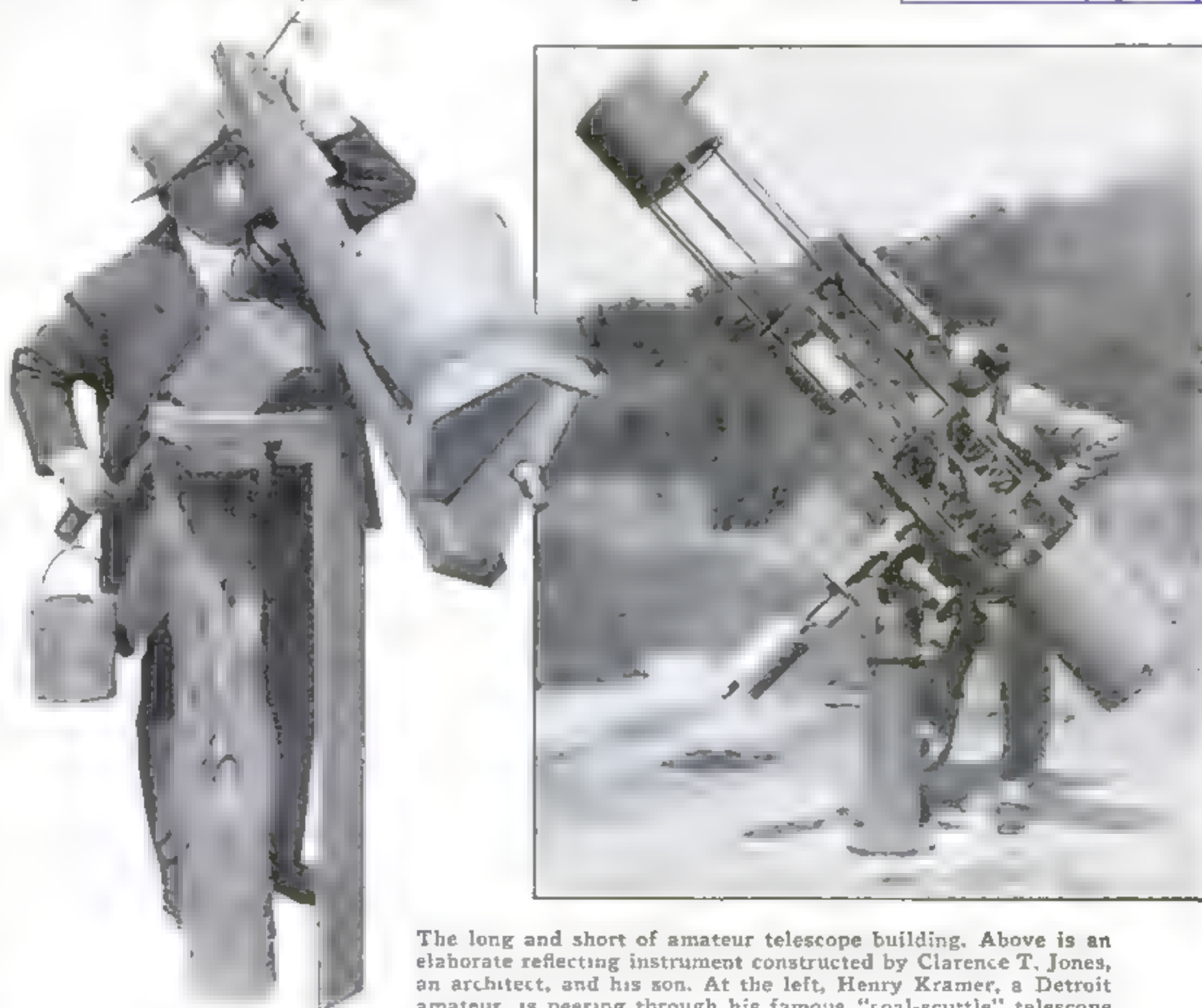
Long-period variables—stars that increase and decrease in brightness during intervals rang-

ing from several months to several years—present a baffling problem. Take, for example, SS Cygni, a variable star in the constellation Cygnus, the Swan. Observed through a small telescope, the star remains in comparative obscurity for an indefinite period, then, suddenly blows up to 100 times its normal brilliancy, only to fade, later, to its former dimness, and to start its erratic cycle all over again.

This star was discovered by astronomers at Harvard in 1896, and has since had more than 50,000 observations on more than 14,000 nights. It has already

charts and report blanks supplied from the headquarters of the Association, at Harvard Observatory, Cambridge, Mass. Each variable star is drawn on the center of a chart which includes, also, the principal surrounding stars in the near-by field. This star field is located by a number which indicates the hour and minute of the star's rising and its declination, or angular distance from the equator of the sky, for the year 1900. If the telescope is of the "equatorial" type, the instrument may be set directly from these numbers. If it is not, the star field may be found by careful maneuvering of the telescope from known stars or constellations.

The American (*Continued on page 100*)



The long and short of amateur telescope building. Above is an elaborate reflecting instrument constructed by Clarence T. Jones, an architect, and his son. At the left, Henry Kramer, a Detroit amateur, is peering through his famous "coal-scuttle" telescope



### BEER IN EVERY DISH

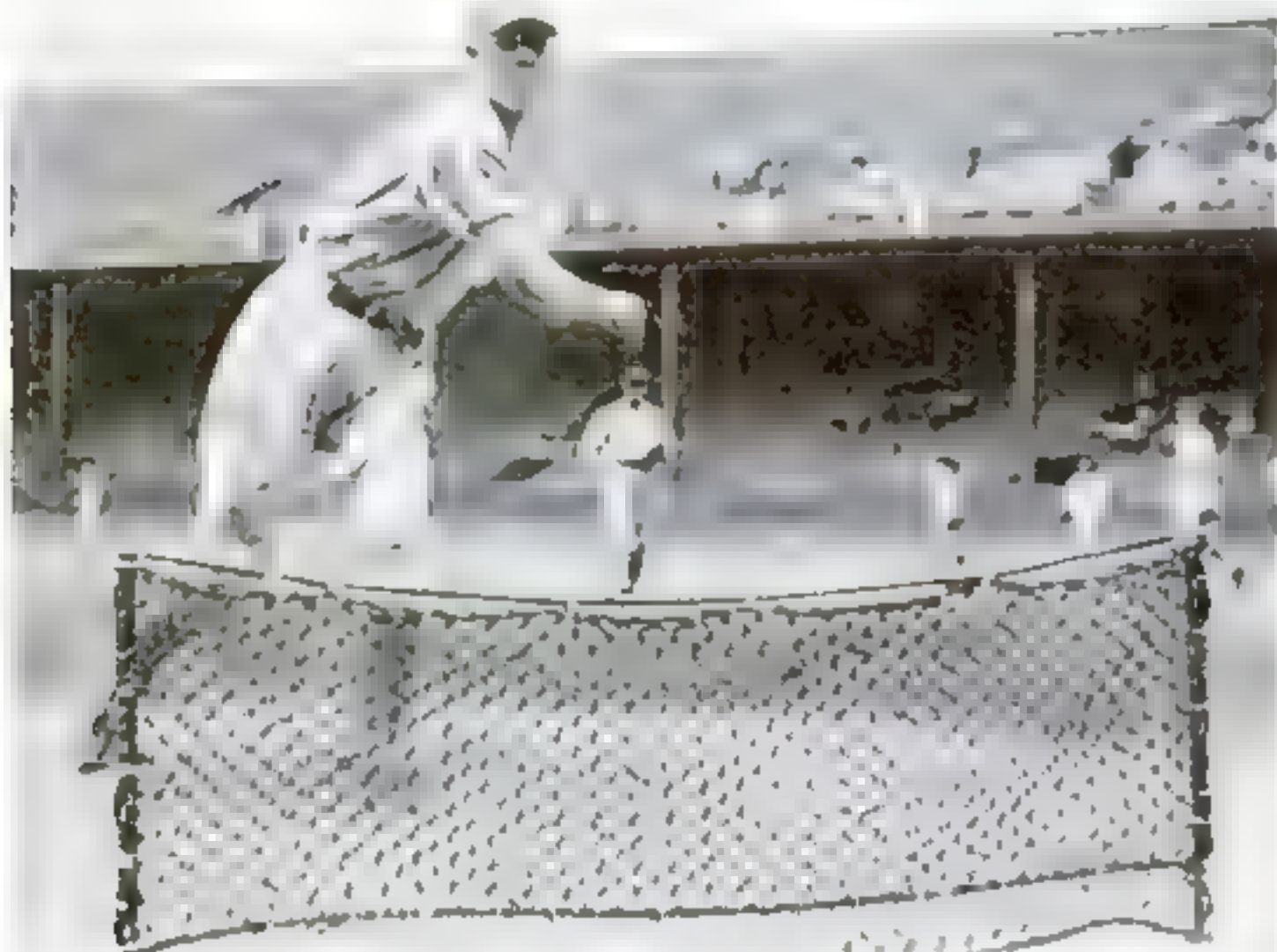
BEER was an ingredient of every dish in a meal recently arranged to demonstrate its value as a food. Seventy-five Chicagoans lunched on beer soup, Welsh rabbit, mixed salad with beer dressing, steak fried in beer, and beer cake.

### SPRAY MARSHES WITH PAINT TO TRACE MOSQUITOES

TO DETERMINE how far mosquitoes fly from the swamps or ponds where they are bred, health officials of Lyons, Illinois, have sprayed each of four near-by marshes with brilliant-colored paints. Armed with odd spray guns resembling vacuum cleaners, a squad of fifty men protected by masks, goggles, gloves, and mosquitoproof clothing waded through the swamps spraying the breeding grounds with red, green, purple, and yellow tints. By coloring the surface of each marsh a different hue, experts hope to trace the movements of the variously colored mosquitoes.



Spraying an insect-infested marsh with paint to trace flight of the mosquitoes



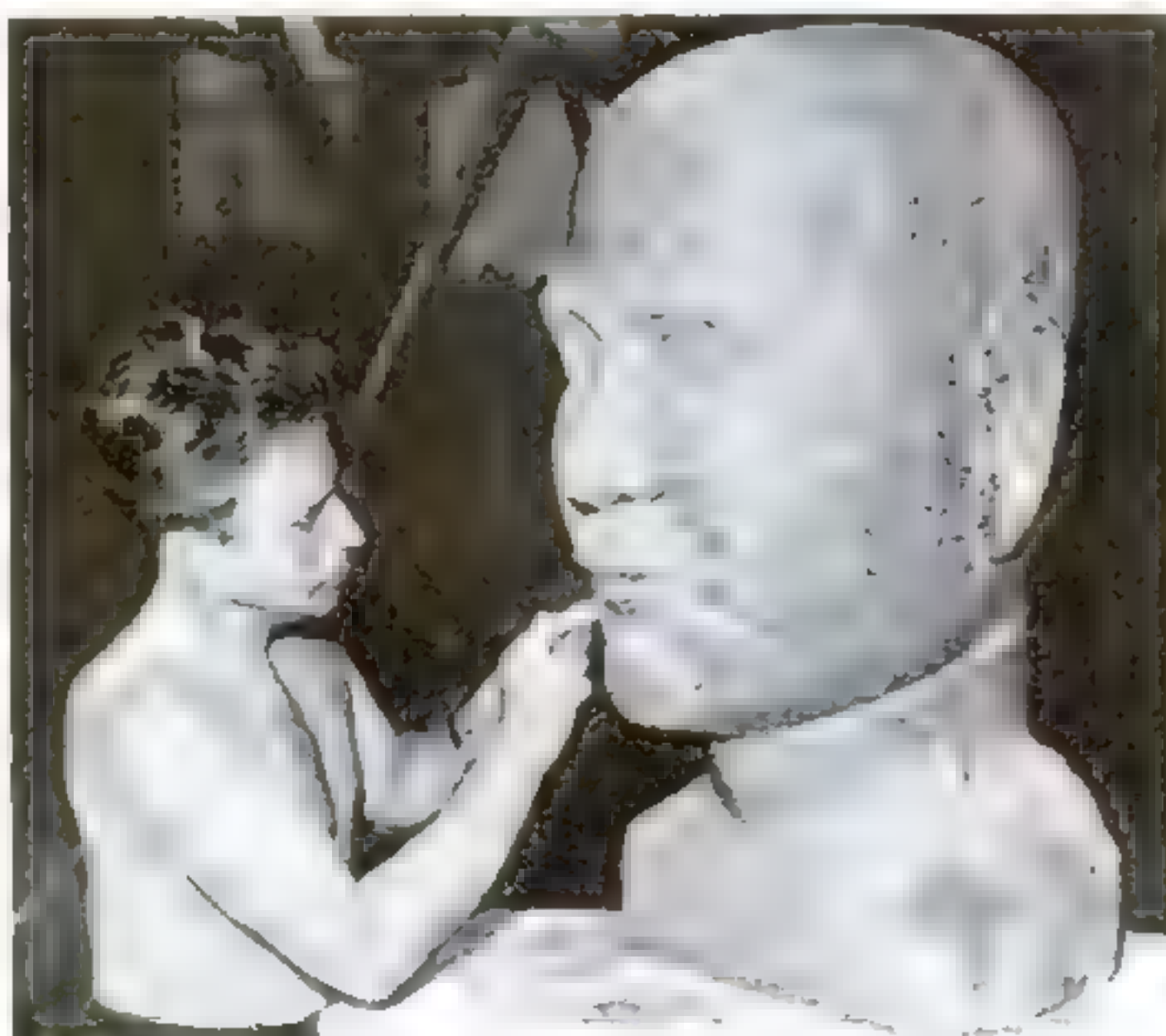
During practice, this net protects the pitcher's legs from grounders

### NET SHIELDS PITCHER IN PRACTICE

TO PROTECT pitchers' legs during batting practice, a low screen is erected in front of the pitcher's mound at Navin Field in Detroit, Mich. Hard-hit grounders and balls that take a bad hop, continual hazards to the pitcher, are caught or deflected by the net.

### CUTS STATUE FROM STEEL AND GRANITE

STEEL and granite are combined in a novel statue designed by Beniamino Bufano, a San Francisco, Calif., sculptor. The head and hands are being carved from red granite, while the body of the statue is being beaten from sheets of stainless steel. The body will be assembled by welding together the different sheets, to which the head and hands will be fastened.



Sculptor working on the head of his novel steel-and-granite statue



### GREEN "BLACKBOARDS" PREVENT EYESTRAIN

GREEN GLASS "blackboards" have replaced the familiar black-slate variety in a school near Toledo, Ohio. The new-type boards, teachers have found, are more restful to the eyes and are easier to clean. Yellow chalk has proven to be best suited for use on the green glass.

### OILS ROAD SUBSURFACE

HAILED as a boon to motorists, a new way of keeping down dust on dirt roads supplants the unpleasant practice of spraying with sticky oil. Instead, the oil is injected below the surface by a machine resembling a corn planter and allowed to work up to produce a dustless road.

# Ghost Ship Haunts the Arctic Ice Pack



Crew of the *Baychimo* removing the cargo of furs from the icebound vessel

**L**OCKED five years in the grip of the polar ice pack, the steel trading ship *Baychimo* still defies the ravages of towering masses of pressure ice somewhere off the northwest coast of Alaska. Once the pride of the Hudson's Bay Company's fleet, the ill-fated steamer regularly transported valuable furs from the Arctic Ocean around the Alaskan coast to Vancouver, British Columbia, Canada. In 1931, the 1,300-ton boat became lodged in the grinding ice pack and was abandoned by its crew. High winds and a phenomenal rise in temperature broke up the ice and carried the ship off, and it was only after weeks of search that the *Baychimo* was located

again. At the risk of their lives, the crew transferred most of the million-dollar fur cargo to dog sledges, and left the ship to the mercy of the arctic. Although no vessel had ever been known to withstand the grinding polar ice for more than two winters, Alaskan natives recently sighted a ship believed to be the *Baychimo*, still miraculously riding the frozen seas. When last boarded, in 1933, the derelict appeared to be practically un-



Our artist's conception of the abandoning of the fur ship under the blazing arctic lights

harmful. Aboard the vessel there lies a priceless collection of anthropological specimens gathered by Richard Finnie on a Canadian scientific expedition.

## SUCKS SMOKE AWAY TO AID FIREMEN

A "SMOKE SUCKER," invented by a San Francisco, Calif., fireman, draws smoke out of burning buildings at the rate of 4,400 cubic feet a minute. Flame-resistant hose is led to points where smoke is thick and a suction is created by compressed air. Use of the device helps firemen to penetrate areas which would ordinarily be inaccessible, blocking the work of fire fighting.



"Smoke sucker" discharging fumes in a demonstration from a building

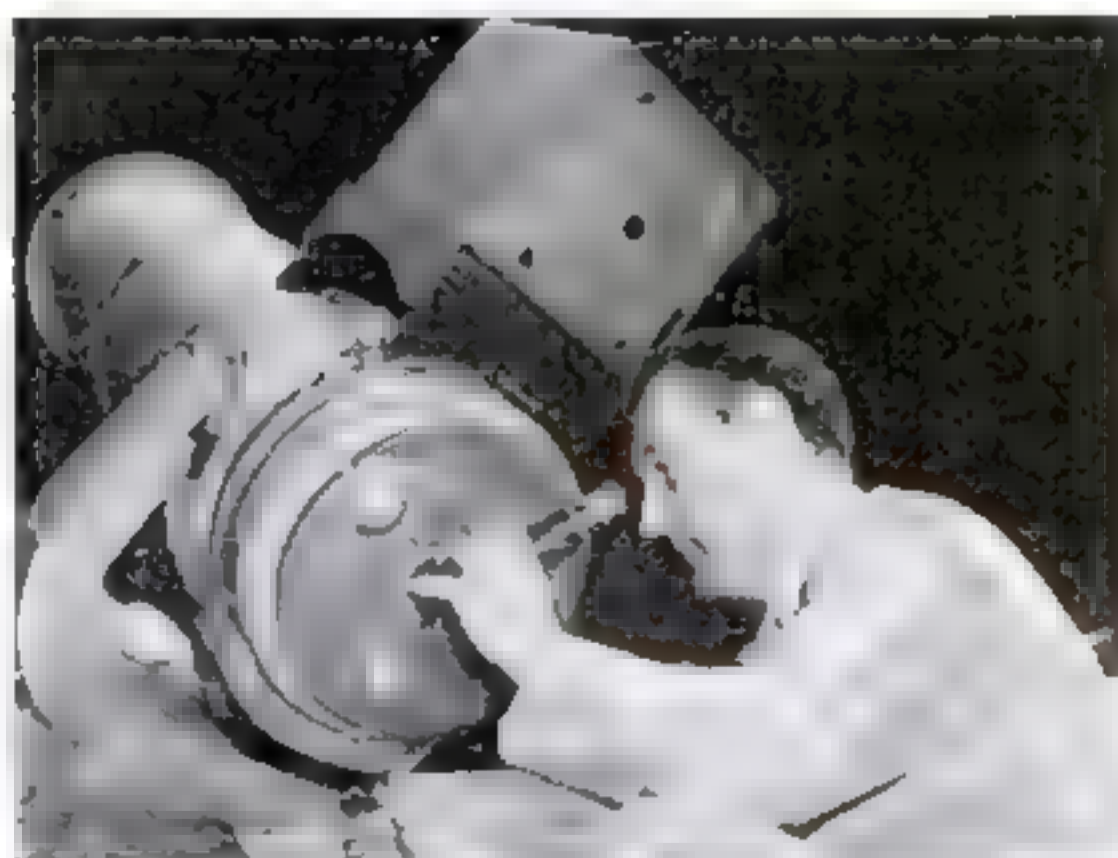


## TELEPHONE BOOTH IS FIRST-AID STATION

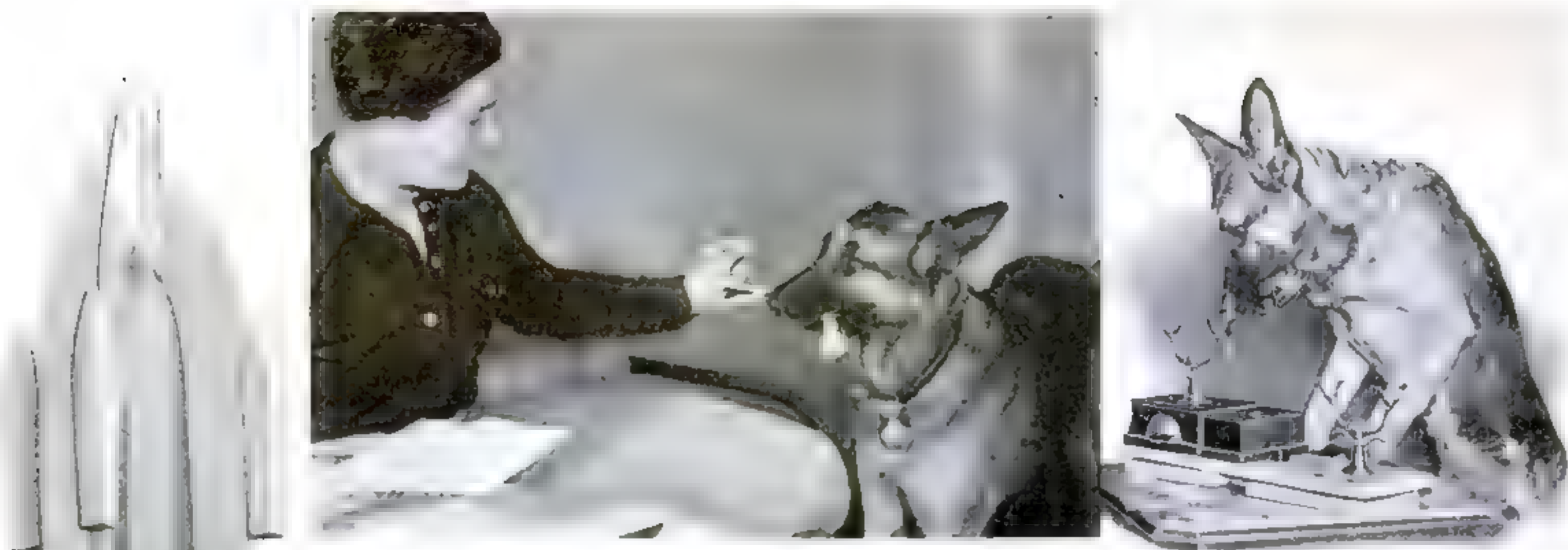
A TELEPHONE booth recently opened for public use on one of the main thoroughfares of Berlin, Germany, can readily be transformed into a complete emergency hospital to provide instant treatment for victims of traffic accidents and people suddenly stricken by illness on the streets. When a button is pressed, the floor of the booth rises to reveal a stretcher, first-aid outfit, and medicine supply. A loudspeaker in the upper part of the booth can be used by police to broadcast official announcements or to give emergency instructions throughout the surrounding area.

## COSMIC RAYS WIN RACE WITH LIGHT

WITH the discovery of a new exploding star in the Milky Way, Dr. Fritz Zwicky, of the California Institute of Technology, believes he has succeeded in gauging the speed of cosmic rays. According to tests made during the observations, cosmic rays from the star won a 2,000-year race with light rays by reaching the earth four weeks before the star was visible. If the calculations prove correct, cosmic rays will supplant light as the "fastest thing in the universe." The discovery is now being checked by J. Clay, noted Dutch cosmic-ray expert.



Dr. Zwicky using his twelve-inch reflecting telescope



## DOGS TRAINED TO HEAR FOR THE DEAF

GERMAN shepherd dogs are now being trained to hear for their deaf masters. A "hearing" dog recognizes bell tones in a house, and leads his owner to the correct door in response to a ring. When a partial-

ly deaf person can hear speech over a special amplifying telephone, the dog will answer the phone, lift the receiver off the hook, as shown above, and then notify his master.

## CHEMICAL SOLUTION FIREPROOFS WOOD

WHEN wood treated with a recently developed fireproofing solution is exposed to flames, each cell or pore acts as a tiny fire extinguisher by emitting a gas which prevents effective combustion. Where exposed, the lumber is merely charred on the surface. The chemical treatment, applied under pressure, is said to last for the entire life of the wood and does not affect in any way its workability or the application of paints, varnishes, or other finishes. The solution slightly increases the weight of the wood.



Shack made of impregnated wood under test for fire resistance

## STRATOSPHERE ROCKET CARRIES INSTRUMENTS

STREAKING skyward at 1,500 miles an hour, a new stratosphere rocket will soar 200 miles into the upper air, according to its California inventor. Propelled by exploding gases, the rocket will carry scientific recording instruments in the cylindrical metal "nose" seen above. At maximum height, the instrument case will be parachuted to the earth, while the rocket blows itself to bits to prevent its falling intact and injuring persons or property on the ground.



Furniture-leveling device and, at right, cross-sectional view showing how it is adjusted as needed

## LEVELER STOPS FURNITURE WABBLE

CHAIRS, tables, desks, and other pieces of furniture that wobble because of an uneven floor surface can be made steady by an ingenious new leveling device inserted in the end of a leg or other floor support. When a set screw on the leveler is turned inwardly by a screw driver, its cone-shaped head forces a steel ball against a vertical metal plunger. This action pushes the plunger downward until it makes a solid contact between the leg and the floor on which it rests.



## INVENTS IMPROVED DESIGN FOR ARTIFICIAL TEETH

ARTIFICIAL teeth of new design, based upon engineering principles, have been introduced by Dr. Victor H. Sears of New York City. The mortar-and-pestle action of natural teeth, he points out, is made practical by the deep roots that anchor them. Since artificial teeth rest on a less secure foundation, there are good reasons for shaping them to act differently. Abandoning human models, he has designed teeth of shallower form, with crests arranged in odd geometrical patterns to increase their shearing power. The "non-anatomical teeth," as he calls them, are used in the back of the mouth, where they do not show, while artificial front teeth are still made in human form. A curious side light on the new style in dentistry was Dr. Sears's discovery that he had unwittingly re-created teeth resembling those of herbivorous animals that lived millions of years ago.



New-type false teeth (at left) compared with natural ones. Above, models show action

## USE GLASS-WALLED ROOM TO STUDY HABITS OF CHILDREN



Children at work in a glass-walled classroom where they can be watched without their knowing it. Inset at left shows how motion pictures are made to preserve scenes for future study. In the oval, note natural expressions of the children

**H**AVING special glass walls which are transparent only from the outside, a classroom at the University of Bonn, Germany, permits psychologists to study the work and play habits of children without the youngsters realizing it. Research experts have been handicapped by the fact that when children know they are being watched they seldom act in a

completely natural manner. With the "one-way" glass, however, boys and girls can be accurately watched and studied without the slightest chance of an outside

observer being seen. All classroom sounds are transmitted outside through hidden microphones, and motion pictures are taken to record the classroom activity.

### CROOKED-BOUNCING BALL ADDS ZEST TO EXERCISE

**M**ADE of sponge rubber with a layer of gum rubber running through its center, a novel ball recently marketed is used for exercising. When bounced on the floor or against a wall, the ball never rebounds as expected, but comes back at an eccentric and unpredictable angle. Players must develop great speed and agility, it is said, to strike the ball and keep it constantly in motion.



"Eccentric" ball cut open to show how it is made

### MAKES LOW-COST PLASTIC

**S**AWDUST can be converted into a plastic molding powder through a process developed by the U. S. Forest Products Laboratory. The material provides a durable, low-cost plastic that can be cast in molds.

### PLANS TO CROSS OCEAN IN BARREL-SHAPED BOAT

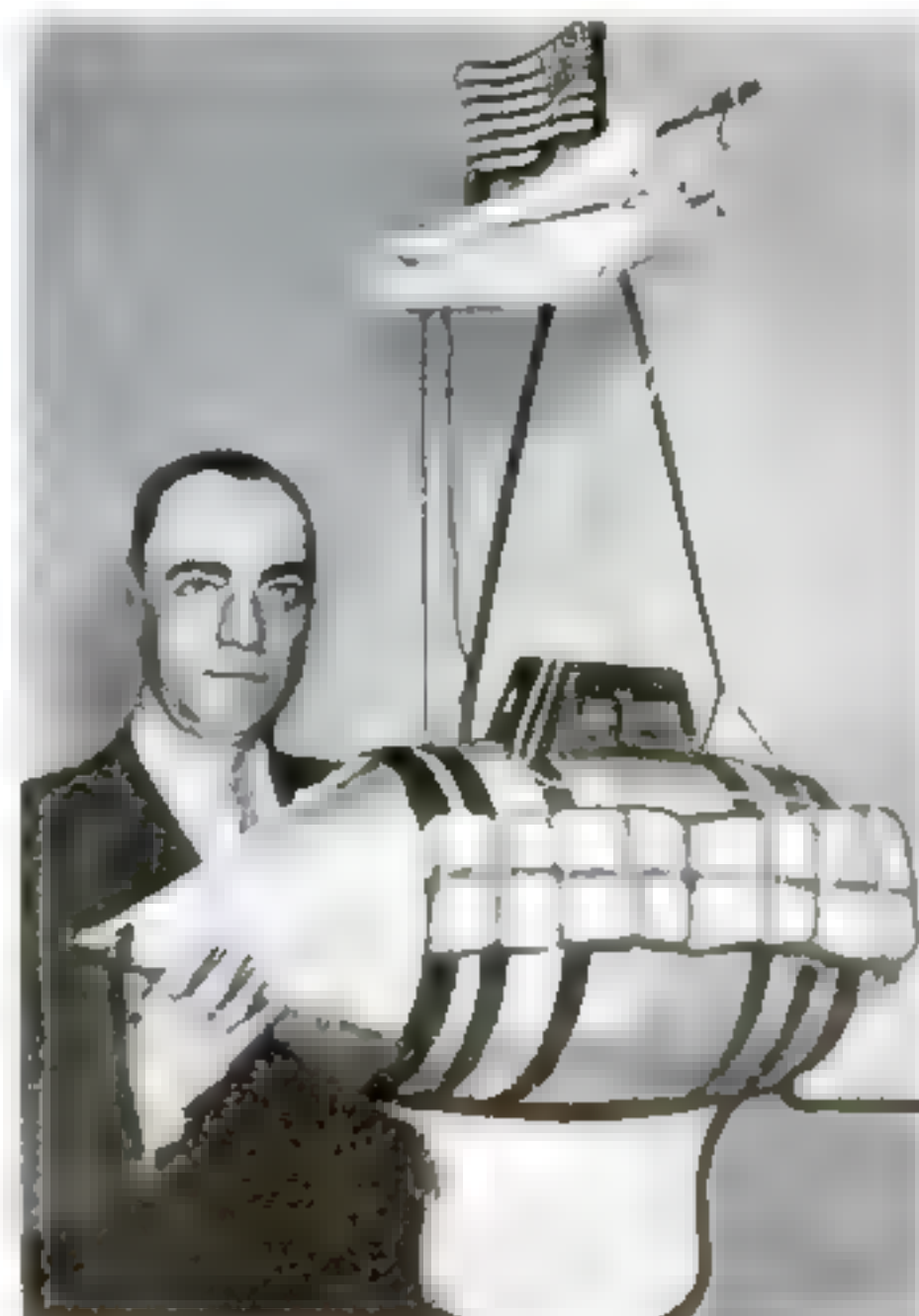
**R**IDING in an odd sailing craft shaped like a barrel and recently constructed by a cooperage concern, an adventurous inventor hopes to cross the Atlantic Ocean in about forty days. The novel barrel boat is nine feet long and about seven feet in diameter, with a cone-shaped prow, 600-pound keel, and glass-covered hatch.

## AMATEURS STAGE RADIO TREASURE HUNT

Participants in a novel "radio hunt" trying to locate a hidden transmitting station (at right) by finding the direction with a portable receiving set. The man holds the actual



**A**MATEUR radio operators recently staged a novel "radio treasure hunt" near Kirkland, Wash. A short-wave transmitting set was hidden in a hilly, wooded section, and contestants were required to find and "capture" it with their portable, battery-operated receivers. Location of the hidden transmitter was determined by judging the direction from which signals of maximum intensity were received. Over fifty enthusiasts participated.



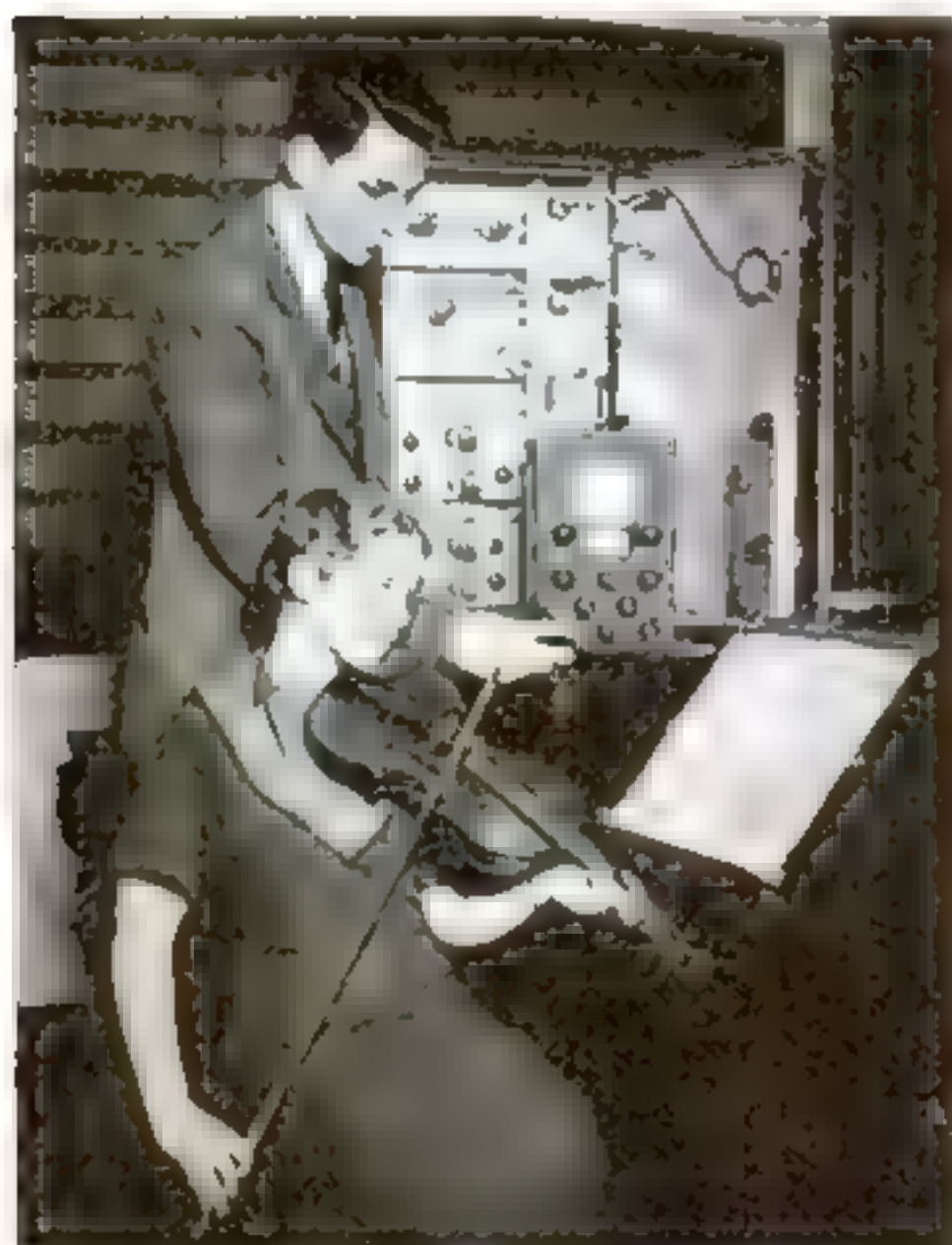
The inventor with a model of his barrel-like boat



Miss Frances Mildred Davis, California X-ray technician, with the apparatus she uses in making remarkable photographs of flowers. At the right is an X-ray study of calla lilies

TAKING X-ray photographs of flowers and plants is the unique hobby of Miss Frances Mildred Davis, an X-ray technician of Los Angeles, Calif. Given a very short exposure under the X-ray lamp, the flowers appear on the developed plate as a

delicate and almost ghost-like pattern of veins, tubes, and membranes. By this novel use of the X-ray apparatus, Miss Davis has achieved many striking and beautiful camera studies like the one shown at the right.



### SOUR-NOTE DETECTOR AIDS MUSIC STUDENT

SOUR or discordant notes are detected by an electrical device recently invented by Prof. George Hannenman of De Paul University, Chicago, Ill. The musical detective is a special type of oscillograph, an electrical instrument for recording wave patterns, and is used in musical-education courses. The apparatus supplies an unerring method of recording the progress made by students of music.

### FINGERS "HEAR" SPEECH

A SCRAMBLED speech, meaningless to the ears but understandable through the fingertips, has been invented by a Northwestern University scientist. Conversion of high-pitched vibrations, familiar to the ear, into low-pitched ones, to which fingertips are sensitive, allows deaf persons to "hear."

### MUSEUM GETS SPECIMEN OF GIANT TOAD

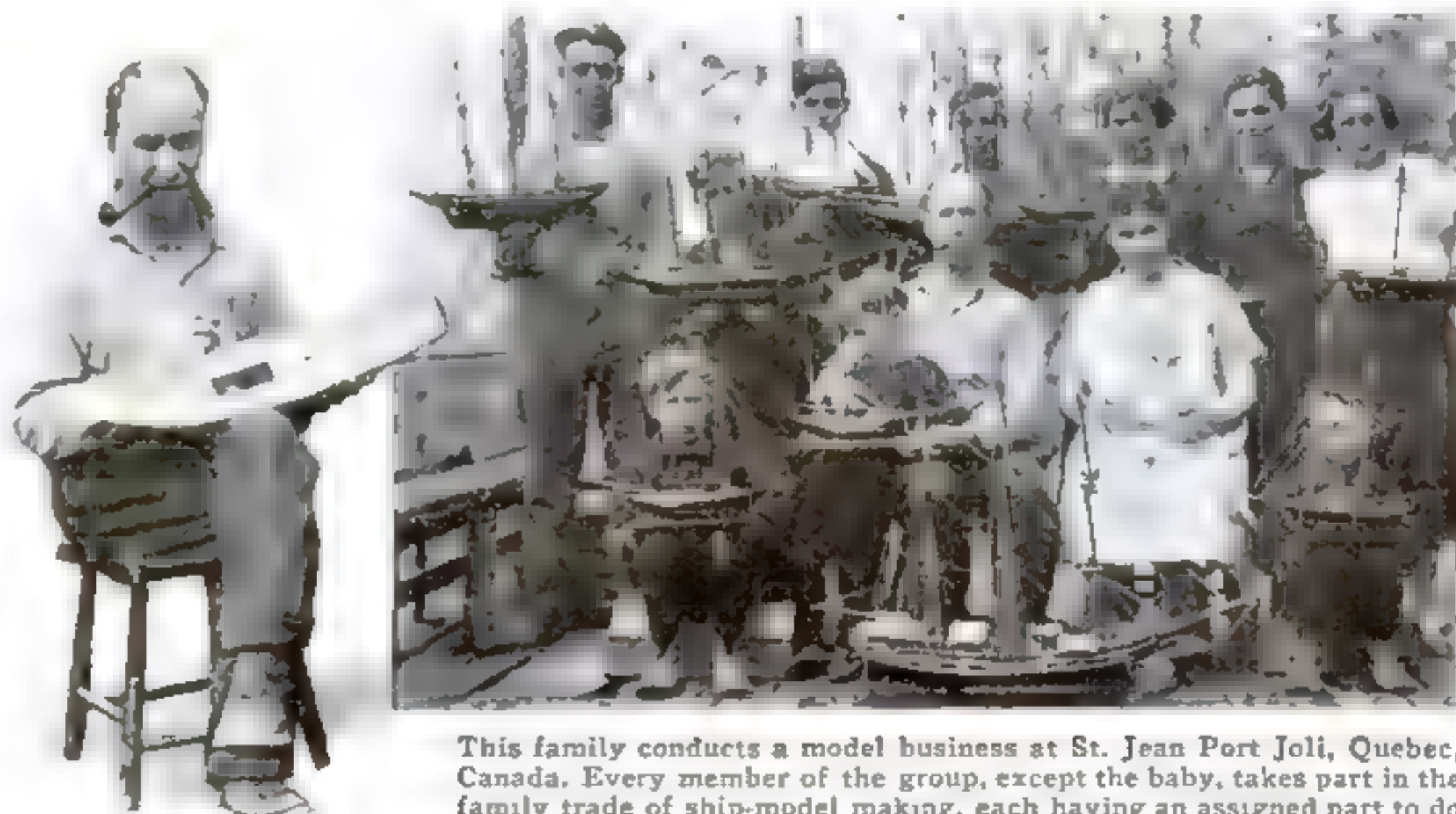
ONE of the largest toads ever shipped to New York City alive is now being studied by scientists of the American Museum of Natural History. A specimen of the *Bufo marinus* family, the giant amphibian is sixteen inches long and weighs a pound and a half. It is pictured at the right with a common tree frog and a watch.



### WHOLE FAMILY WORKS AT MODEL MAKING

MAKING models of old sailing craft is a family business in the home of Eugene Leclerc, retired sailor of St. Jean Port Joli, Quebec, Canada. Each member of the family, except the baby, is assigned to a particular task. The father carves the hulls and erects the masts. The older boys

make anchors, cabins, lifeboats, davits, and other small parts, while the younger sons carve out wooden pulleys. The daughters sew the sails, while Mrs. Leclerc attends to the rigging and varnishing of the models. Below the family is shown with a number of model ships.



This family conducts a model business at St. Jean Port Joli, Quebec, Canada. Every member of the group, except the baby, takes part in the family trade of ship-model making, each having an assigned part to do

# Raises Rare Jungle Birds

## IN A HOMEMADE AVIARY



Gilbert C. Lee placing a tropical bird in the odd "hospital" box in which it will be gradually acclimatized to the weather conditions of its new home



This baby Veni-Kuhli is the only one of its kind ever hatched in captivity in the United States



The two electric heating coils that reproduce equatorial temperatures for feathered guests

**R**ARE tropical jungle birds, which formerly could not be raised in the United States, are now acclimatized and bred in an electrically heated "hospital" devised and operated by Gilbert C. Lee, inventor and retired business man of Los Angeles, Calif.

When specimens of the beautiful Veni-Kuhli and other birds of the lory and parrot families arrive at American ports, they are sped to this novel aviary by airplane. There they are placed in the "hospital," which consists of a square box covered with a special glass that permits the vitamin-D rays from the sun to reach the birds. Inside, the temperature duplicates that to which they have been accustomed in their forest homes.

For the first two weeks, the temperature is reduced two degrees every four days. After that, it is reduced two degrees every two weeks, until it reaches the atmospheric temperature of Los Angeles, which is seldom more than fifteen degrees lower than the average temperature of the



Exterior of the aviary in which Lee raises hundreds of jungle birds under conditions closely resembling those to be found in the tropics

birds' natural habitat. In this manner, they become acclimatized.

Heating is accomplished by two inexpensive electric elements connected in series and placed near four one-inch openings at the bottom of one side of the box. The heated air passes through the cage and goes out through four similar holes at the opposite side near the top. An adjustable thermostat, placed near the center of the box to obtain average temperature, controls the heating elements.

Tropical conditions are reproduced in

several ways so that the birds will have surroundings resembling those of their original jungle homes. Nesting and feeding conditions, as well as climate, have been made as nearly natural as possible. For his three Veni-Kuhli, including the only baby one ever hatched in captivity, Lee supplies a nesting place in moist earth. The parent birds are the only two now alive, out of forty-eight shipped from the Washington and Fanning Islands in 1930. Habits of other birds are studied as they nest in natural tree trunks which have been cut in half and hinged to make observation easy.

The bird fancier attributes his success with these rare creatures to the unique "hospital" and to proper feeding. By observing the birds, he discovered the foods they took from plants, and prepared for them a mixture of milk, honey, white corn meal, barley and oat flour, and ground wheat. This is fed to the young birds by spoon until they become able to select their own foods.

To date, 400 tropical birds, many of them never before raised in captivity, have been acclimatized by the Lee methods, and he has succeeded in producing young Forsten lorries as well as the one Veni-Kuhli.

# Amazing Voyages Made in



Capt. Tom Drake, one of the modern sea rovers, on the deck of his schooner *Progress*. This vessel, shown at the right, is built on the lines of a Norwegian pilot boat and is the fourth ship that Drake has made for himself

THIS ARTICLE TELLS  
ABOUT SOME OF THE  
DARING ADVENTURES  
OF MODERN VIKINGS  
WHO SAIL THE SEAS  
FOR THE FUN OF IT

By  
Jesse F.  
Gelders



*Svaap*, the thirty-two-foot ketch in which William Robinson sailed around the world. His adventures included a brush with pirates

SHIPS arriving at Sydney, Australia, recently, reported a violent storm. It had torn the rails off some vessels, swept lifeboats from others. A big, 9,000-ton freighter came in, its bridge jammed backwards eight inches on the steel superstructure.

Several days later, a little sailboat slipped blithely into the same port. It had a crew of only two men, one of them its owner and captain, Dwight Long, an American. It was just forty feet long, and could almost have been carried by the big freighter in place of one of the lifeboats that were washed into the sea. Yet it had weathered the same storm!

That little craft, which left Seattle, Wash., in September, 1934, is just one of a growing fleet of small boats that are sailing today on amazingly bold voyages. Scattered over the seven seas, there are more than a dozen such vessels, none over forty feet long, cruising around the world. Several are sailed by their owners, single-handed; others carry two men each. At least three are in the South Sea Islands. One, as this is written, is somewhere on

the way from England to America. Others, from time to time, arrive unannounced at various distant ports.

In surprising ways, they combine science's latest aids to navigation with the ancient bare-knuckled arts of sailing. The Corinthians, a club of navigators and yachtsmen, recently sponsored a visit by 500 enthusiasts to the Hayden Planetarium, at the American Museum of Natural History. There, in the shelter of a building in the heart of New York City, they studied a vivid likeness of the heavens as they would appear, several months later, above the seas on the way to Bermuda. That scientific show was of special interest to those of the navigators who intended to participate in the biennial Bermuda race, sponsored by the Cruising Club of America.

Aviation has helped bring a vast simplification of the once mysterious and complicated science of navigation. Flyers found that after they had made observations to learn their position, they might speed 100 miles farther, while they were completing computations necessary to find where they were. So tables have been worked out to reduce the mathematical work to little more than adding and subtracting.

Those tables are of inestimable value to small-boat sailors. Skill is still required to take sights with the sextant—especially from a heaving deck—but the calculations are no longer mysterious and forbidding intricacies.

One skipper taught himself navigation evenings, in the New York Public Library, and then, with one companion, sailed a thirty-two-foot ketch around

# Tiny Sailboats



Robinson "shooting the sun" in midocean. Modern aids to navigation, designed for airplane pilots, also help small-boat skippers find their way across vast reaches of sea. Left, one of the speedy yachts in a recent race to Bermuda

the world. His calculations became so accurate that on the last leg of his voyage, after crossing the Atlantic by a course nearly 4,000 miles long, he picked his way through a dense fog and found the bell buoy off Morehead City, N. C., exactly where he expected it!

Somewhere on the Pacific, according to latest reports, Harry Pidgeon, past sixty years old, is cruising with friends in a thirty-four-foot yawl, *Islander*, which he built eighteen years ago, at a cost of \$1,000 and a year and a half of labor.

He sailed out of Los Angeles Harbor, to circle the globe alone. While he slept, his little ship, with her sails expertly set, kept steadily on her course. During a wind and rain storm in the Indian Ocean, *Islander* made seventy miles under short sail in a single night, while the skipper stayed below, out of the wind and wet!

**SLEEP**, while sailing, almost brought disaster twice, in the Atlantic. Once the wind shifted and the boat was driven ashore. At another time, a tanker collided with it. But both times Pidgeon had the damages repaired and went on his way. He was nearly four years making that 'round-the-world voyage.

Capt. Tom Drake, another of the sea rovers, has proved almost as much of a shipwright as a mariner. Some twenty years ago, he was in the lumber business near Seattle, Wash., after having spent his early life

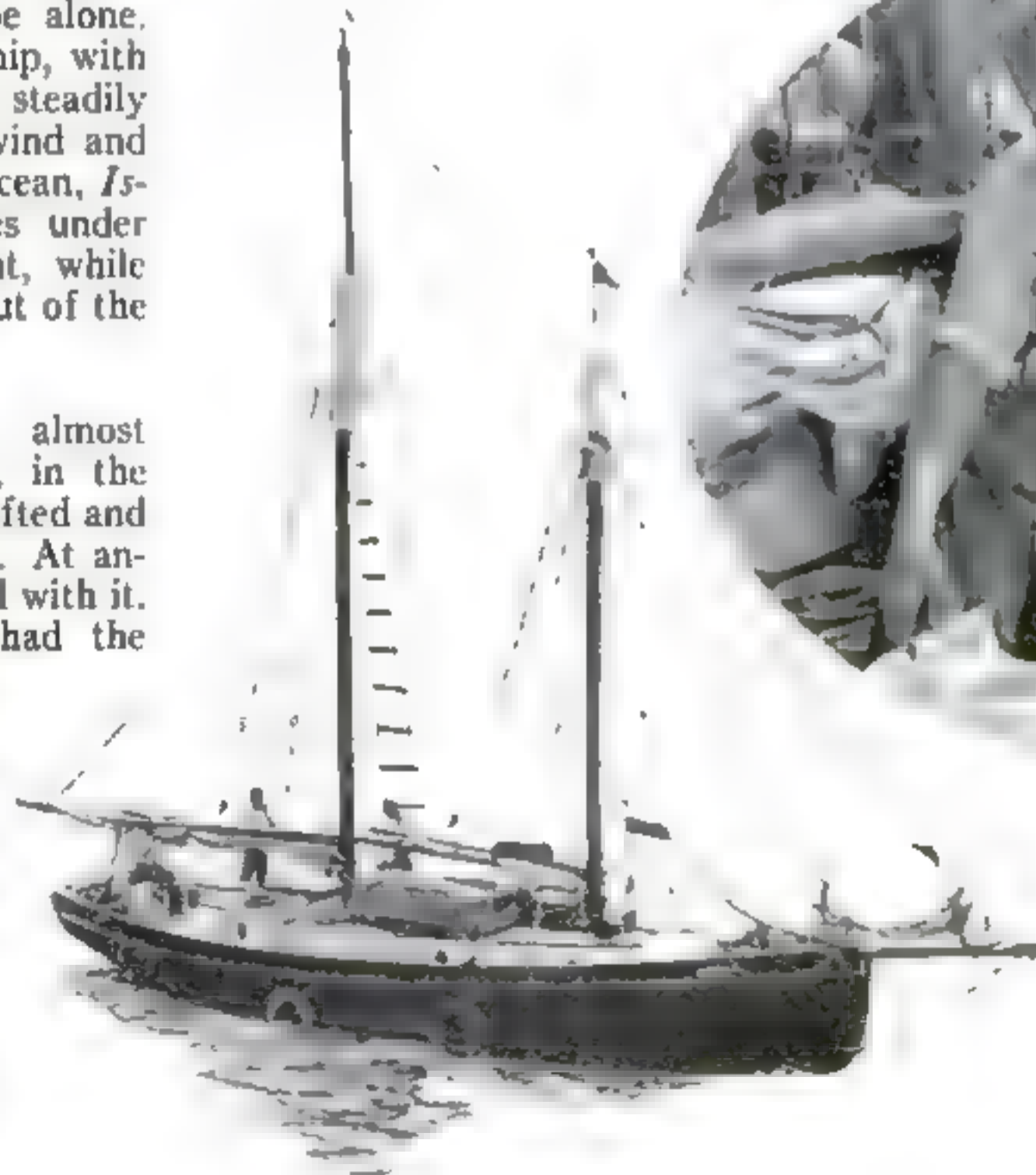
at sea. He decided to whittle a model from a block of wood. The model turned out to be a double-ender, of the Norwegian pilot-boat type. In three months, with the help of a friend, Drake built a ship from the model!

The boat was thirty-two feet long and had a ten-foot beam with a draft of three and a half feet. It had, besides sails, a five-horsepower motor which would enable it to traverse inlets and small streams. For about five years Drake roved the world alone in that boat, going where he

chose, until a severe off-shore gale wrecked him on the west coast of Mexico.

But Drake knew exactly how to get a new boat. He went home and built it, and sailed away again. The second boat finally was wrecked on a reef near Cuba. He returned to Seattle, and with the aid of a couple of friends, built another. A gale wrecked this third boat, off Holland. Even this didn't discourage him. When last heard from, Captain Drake, seventy-two years old, was sailing his fourth home-made ship!

Naturally, it *(Continued on page 90)*



## A TRIO OF DARING ADVENTURERS PLAN A VOYAGE AROUND THE WORLD

Fred W. Boardman, Charles A. Powell, and Mort R. Miller looking over their maps and charts before the start of a globe-girdling cruise. They sailed a few weeks ago from a New Jersey port in the schooner at the left

# Spoon-Fed PLANTS

By ANDREW R. BOONE

**P**ICTURE nodding heads of wheat ripening under blue artificial suns, their roots growing not in soil, but in water; or tomatoes, producing 700,000 pounds an acre, growing in excelsior and water; or orchard and forest trees thriving without benefit of soil.


In the laboratories and greenhouses at the University of California I saw, recently, a dozen kinds of plants approaching maturity, in conditions duplicating those of nature, from the north pole to the equator, with a few synthetic conditions added for good measure.

Trees, which already have borne fruit, were growing in garbage cans, their nourishment taken from water which is "fed" once each week from a bottle. Sequoias, held upright by corks, were reaching their branches toward the sky, their roots spread out in shallow pans. Sunflowers, tomatoes, potatoes, carrots, barley, and wheat likewise have been grown on these "water farms," and produced lush yields far beyond the dreams of dirt farmers.


Some are exposed to natural sunlight and grown at ordinary temperatures; others reach maturity under the glare of synthetic suns, their roots held at one temperature, their heads at another. One plant is fed one diet, its neighbor thrives on quite another. From these controlled lights, diets, and temperatures, some surprising results have been attained.

Take wheat. In the miniature wheat fields, housed within glass show cases in two aluminum-walled basement laboratories, Prof. A. R. Davis needs only to turn a switch, and breezes fan the growing grain; he turns a second knob, and the temperature rises to 110 degrees or falls to freezing; he adjusts the air intake, and the plants are subjected to the aridity of a desert or humid ocean breezes.


As for sunlight, he can produce not one but a dozen suns, ranging from blue through natural sunlight to bright red. These, shining from brilliant lamps ranged around the show cases, may "rise" singly at different times, or all together, and cast their glare on the grain until the scientist decides that the green blades have had enough for the day. Ordinarily, the day commences for these incubator



This French prune tree has been growing for four years in a garbage can filled with water containing a nutrient solution. It is one of a group being cultivated under controlled conditions for a study to check fruit disease.



A chemist taking a sample of the solution from around the roots of a tree in the experimental "orchard." Chemicals are added, when needed, to keep the acid-alkali balance.



Week-old sunflower plants serving as guinea pigs in a test to show the relation between plant diet and disease. The bottles contain liquid food, and oxygen is supplied by means of the rubber and glass tubing.

# Reveal Secrets of Growth

*Fruits, Vegetables, and Grains  
Thrive and Ripen Without Soil  
In Tests To Increase Production*

plants at five o'clock in the afternoon, and the suns "set" at nine in the morning.

These phenomena are not natural, Dr. Davis explained as I observed the blue suns beaming on several trays of sturdy wheat. All are synthetic products of scientific ingenuity to catch nature off her guard and wrest from her the secrets of plant growth. What I saw was literally a scientific third degree, intended to elicit the secrets of life processes in the plant world.

"Such strong-arm methods," Dr. Davis commented, "are essential if man is ever to understand and control his fundamental food source, the plant kingdom."

Nature never reveals these little-known facts. Soils vary from place to place and from season to season; the climate of one year is never exactly the same as it was the year before or as it will be the next; intensity of the sunlight changes; the humidity of the air rises and falls, and temperature is influenced by many factors.

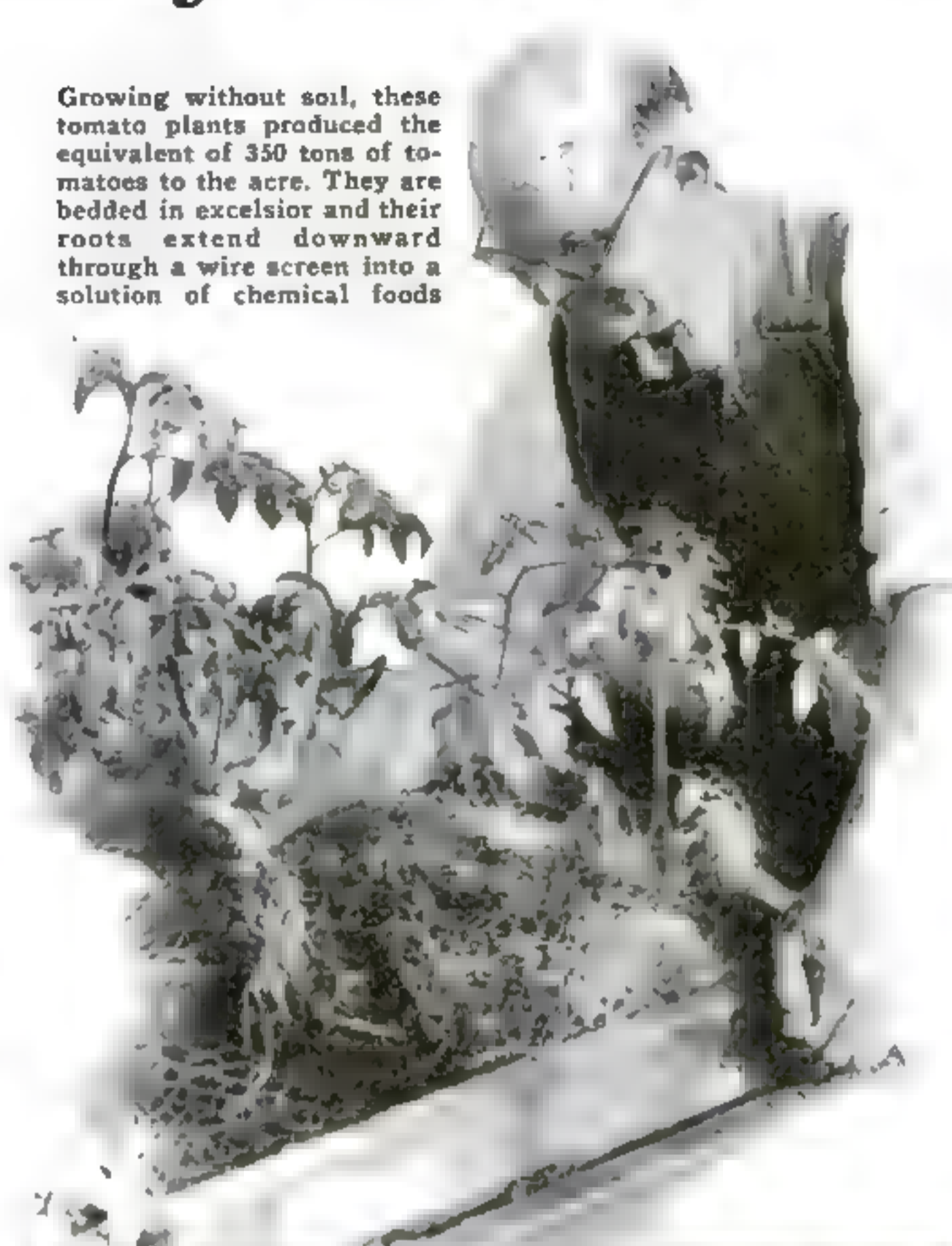
So, here in the laboratory, the scientist substitutes for uncertain nature known temperatures, humidity, and light. He also supplies to the roots nutrient solutions containing measured quantities of liquid foods.

To go back to the real beginning of these experiments, the descendants of a single grain of "little club" wheat, a native of California, were established as a pure line at the University of California College of Agriculture. After they had proved themselves constant, selected grains were brought to the laboratory and planted.

Here, the planting bears little resemblance to the common agricultural method. The grains first are soaked overnight in cool water to loosen their skins, then placed on a metal screen. A second moistened screen serves as a cover, thus providing a saturated atmosphere both above and below.

For three days, the germination pan is left in a darkened cabinet. During this time the roots will have felt their way down into the water, and the tops begun to sprout. As soon as the tops appear, the synthetic sunlight is turned on to begin the manufacture of green coloring matter for the *(Continued on page 109)*

Growing without soil, these tomato plants produced the equivalent of 350 tons of tomatoes to the acre. They are bedded in excelsior and their roots extend downward through a wire screen into a solution of chemical foods



Wheat ripening in a temperature-controlled glass case under the glare of artificial suns. No soil is used in this experiment, the stalks growing out of pools of water like pond lilies. At the left, wheat grains are being "planted" in a moisture-saturated pan for cultivation under red "sunlight"



Powered by a small engine mounted over the front wheel, this novel cycle is economical to run

## Odd Motor Cycle Uses Front-Wheel Drive



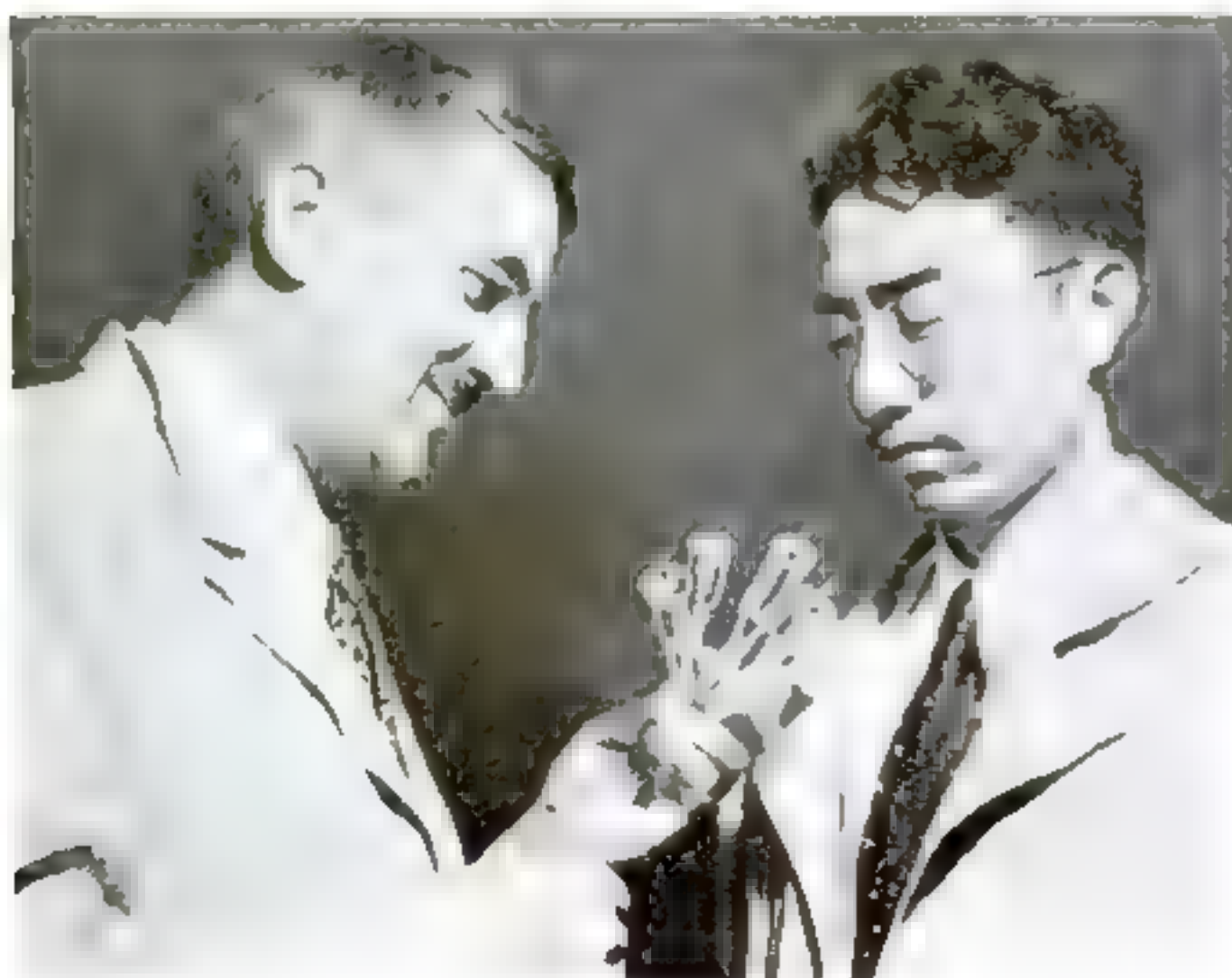
**R**OLLING along on diminutive, balloon-tired wheels, a new motor cycle of odd design will run more than 170 miles on one gallon of gasoline, according to its California inventor. The novel vehicle has a tubular frame resembling that of a girl's bicycle, and is powered by a light motor mounted on a small platform above the

front wheel, which is used for both steering and traction. Brakes are applied by means of a foot pedal which presses a friction shoe against the rear tire. Accelerator and gear-shift levers are attached near the ends of the handlebars. The conventional motor-cycle saddle is replaced by a flat, cushioned seat.

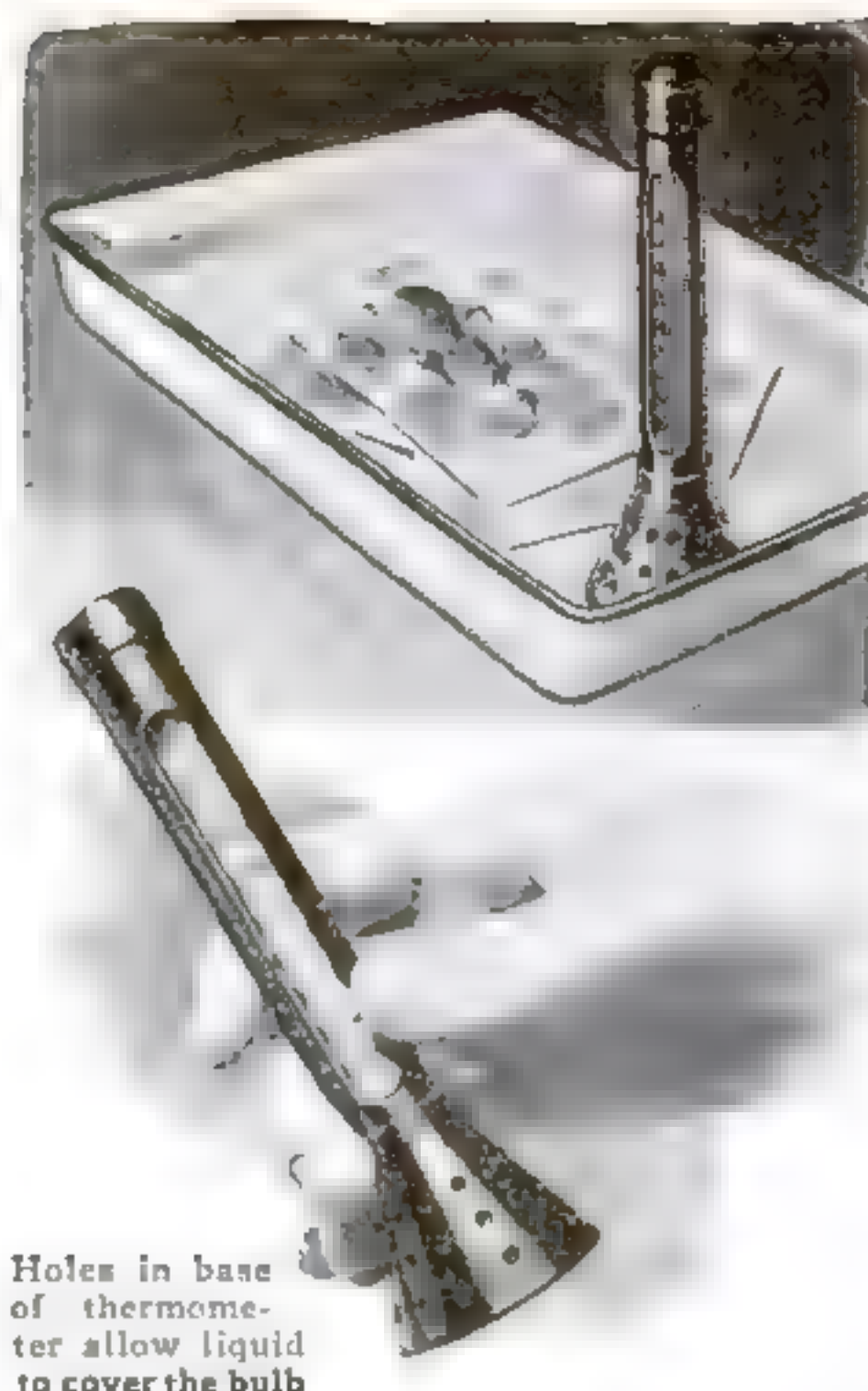
## TINY VACUUM TUBE PROBES MOLECULES

So **TINY** that its filament is dwarfed by an ordinary house fly, a new vacuum tube completed after three years of research by Dr. C. Y. Meng, Chinese scientist, was recently demonstrated at the California Institute of Technology, Pasadena, Calif. Believed to be the smallest vacuum tube now in existence, it was designed to operate on a wave length of one third of an inch. This may be compared to standard radio tubes which will operate efficiently

only on wave lengths as short as ten meters, or approximately thirty-three feet. Mounted in a base of solid glass, the diminutive tube is being put to practical use by Dr. G. W. Potapenko, Russian scientist, pictured below, at left, with Dr. Meng. In his current research studies, Dr. Potapenko is using the tiny waves emitted by the midget tube to aid him in carrying out the experiments in which he is probing into the structure of molecules.



At left, Dr. G. W. Potapenko, Russian scientist, is holding several of the midget vacuum tubes that he is using in a study of the structure of molecules. With him is Dr. C. Y. Meng, who developed the tube after three years of research. Above, the tiny tube elements compared with a fly



Holes in base of thermometer allow liquid to cover the bulb

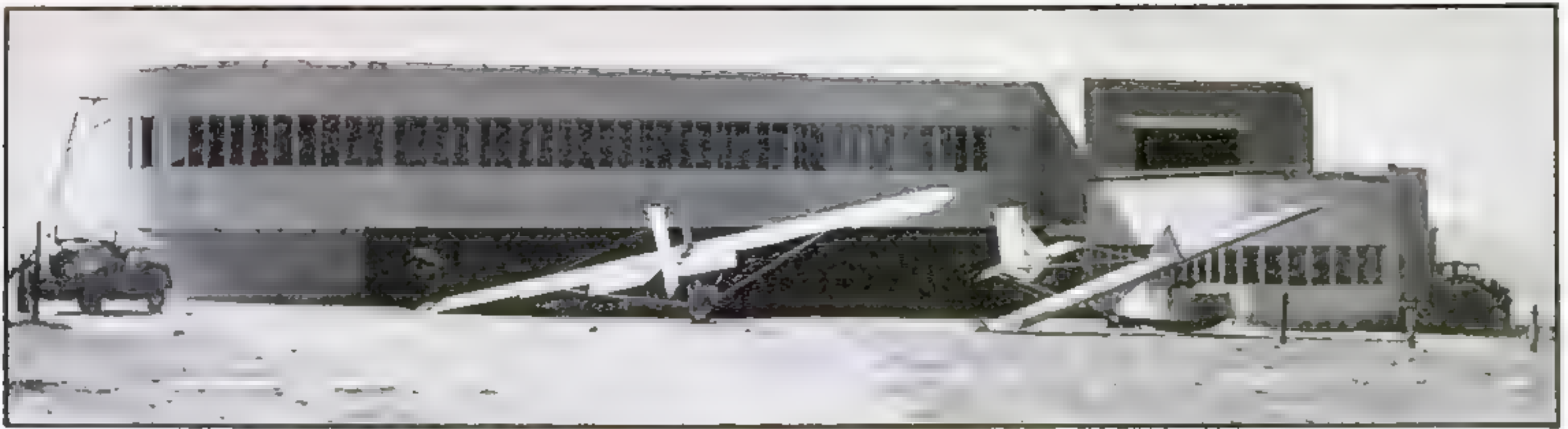
## STANDING THERMOMETER AIDS PHOTO DEVELOPING

**C**ONSTANT watch over the temperature of photographic developing solutions is made possible by a thermometer that has a conical base of hard rubber which keeps it upright in a corner of the tray. Holes in the base allow the solution to cover the bulb, which is so shaped that it can be submerged in a quarter inch of fluid.



## MAMMOTH MICROMETER IS CLASSROOM MODEL

To **HELP** his science students learn how to read a micrometer quickly and accurately, R. E. Kummer, instructor at the Brooklyn Technical High School, Brooklyn, N. Y., devised and built the huge model micrometer pictured here. Made of aluminum, the giant measuring instrument is constructed on a scale of five inches to one, and can easily be read in the classroom at a distance of thirty-five feet.



## HUGE HANGAR HOUSES GLIDERS FOR BRITISH CLUB

ONE of the largest aircraft hangars in Great Britain, recently completed for the London Gliding Club, attests the growing popularity of the sport of gliding in Eng-

land. Designed by a club member and built on the top of a high hill, the modern glider garage measures ninety feet by 100 feet, and houses the fifteen gliders belong-

ing to the club as well as many private craft owned by individual members. The exterior of the hangar is shown in the photograph above.

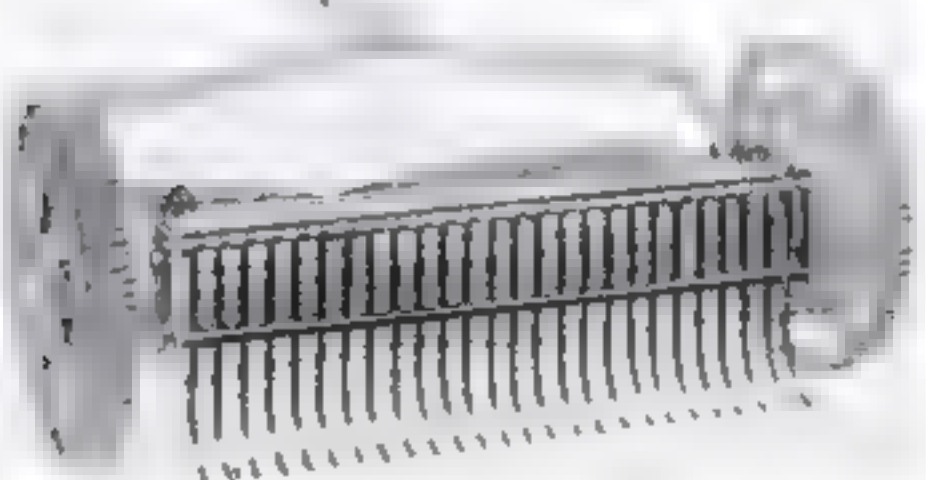


## CHEMICAL "PIPE" SHOWS HIDDEN FINGERPRINTS

IODINE "smoke," blown from a chemical "pipe" devised by a California scientist, is used to detect hidden fingerprints. Air blown into the pipe through a rubber tube circulates through glass tubes containing iodine crystals and a calcium compound, and is ejected as a heavy purple vapor onto the surface being examined. If fingerprints are present, the fumes will cling to the pattern, and the print can be photographed on a sensitized silver plate.

## RAKE ATTACHMENT RIDES FRONT OF LAWN MOWER

CLAMPED onto the front crossbar of any standard lawn mower, a new raking attachment lifts up tangled grass and creeper weeds so that the mower blades will cut the lawn efficiently and evenly. The lawn comb also protects the cutting blades from stray twigs and stones.



This rake clears the path ahead of the mower

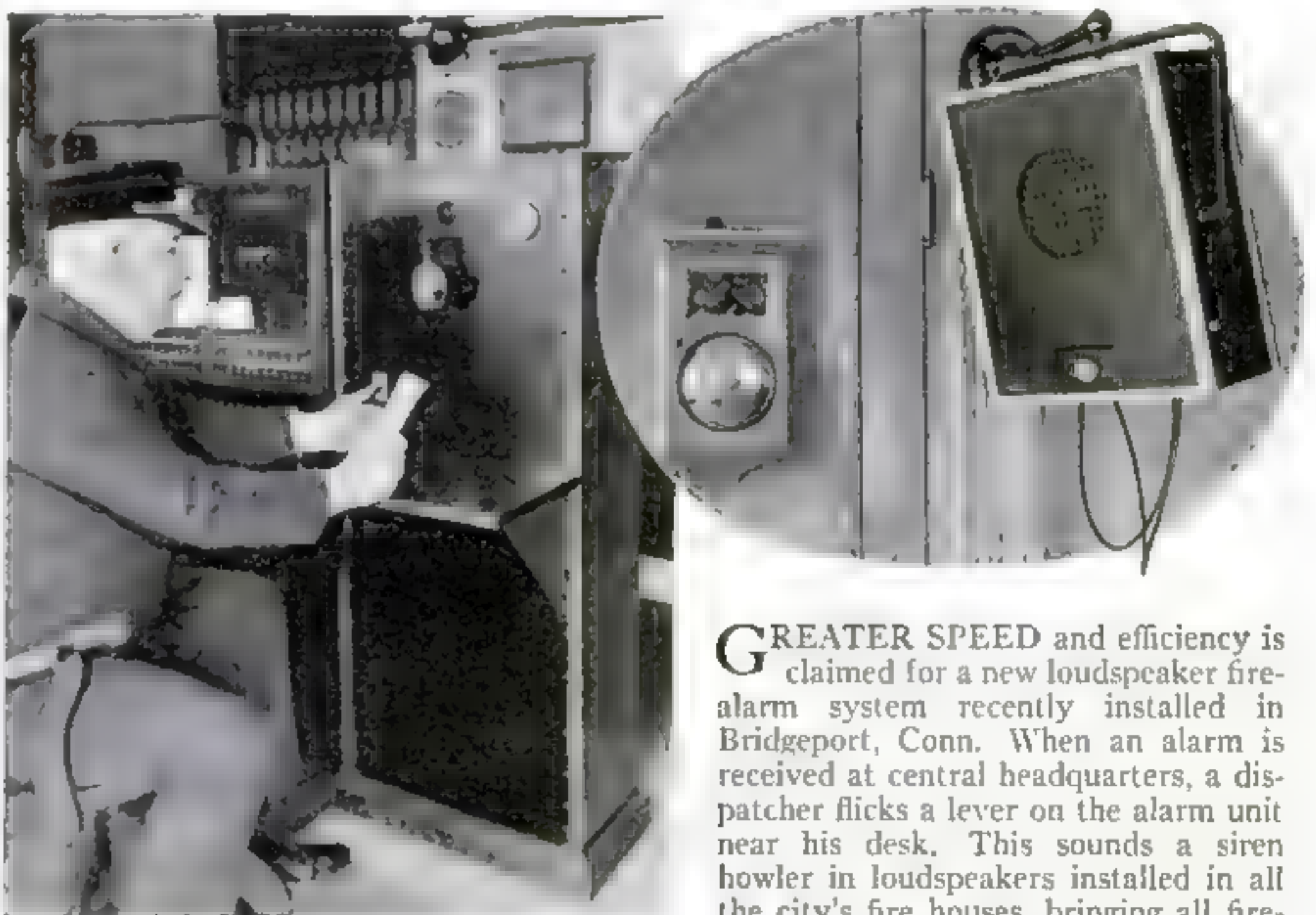
## TRUCKS TEST TELEVISION TRANSMISSION

TO DETERMINE the best locations for a network of television stations soon to be installed in Germany, a caravan of twenty Diesel-powered trucks recently toured the countryside making a series of test transmissions from various points. The mobile television units carried two transmitting sets, one for sound and one for the television image. Thirty engineers and technicians were employed in making the tests.



Mobile television units used in seeking sites for permanent stations

## LOUDSPEAKERS TRANSMIT FIRE ALARMS



Dispatcher at fire headquarters throwing a lever that sounds an alarm in all stations. Verbal instructions spoken into the microphone on the panel are received through loudspeakers like the one in the oval, installed inside the various fire houses

GREATER SPEED and efficiency is claimed for a new loudspeaker fire-alarm system recently installed in Bridgeport, Conn. When an alarm is received at central headquarters, a dispatcher flicks a lever on the alarm unit near his desk. This sounds a siren howler in loudspeakers installed in all the city's fire houses, bringing all firemen to attention. Speaking into the system's microphone, the dispatcher then orders one or more companies to the scene of the fire.

## STREAMLINE FIRE ENGINE CARRIES LADDER ON ITS BACK



At the scene of a fire, the extension ladder is detached and rolled into position wherever needed

**FIREMEN** ride in the covered central compartment of a new streamline fire engine just placed in service in England. The modern fire fighter has a top speed of sixty miles an hour and can pump 1,000

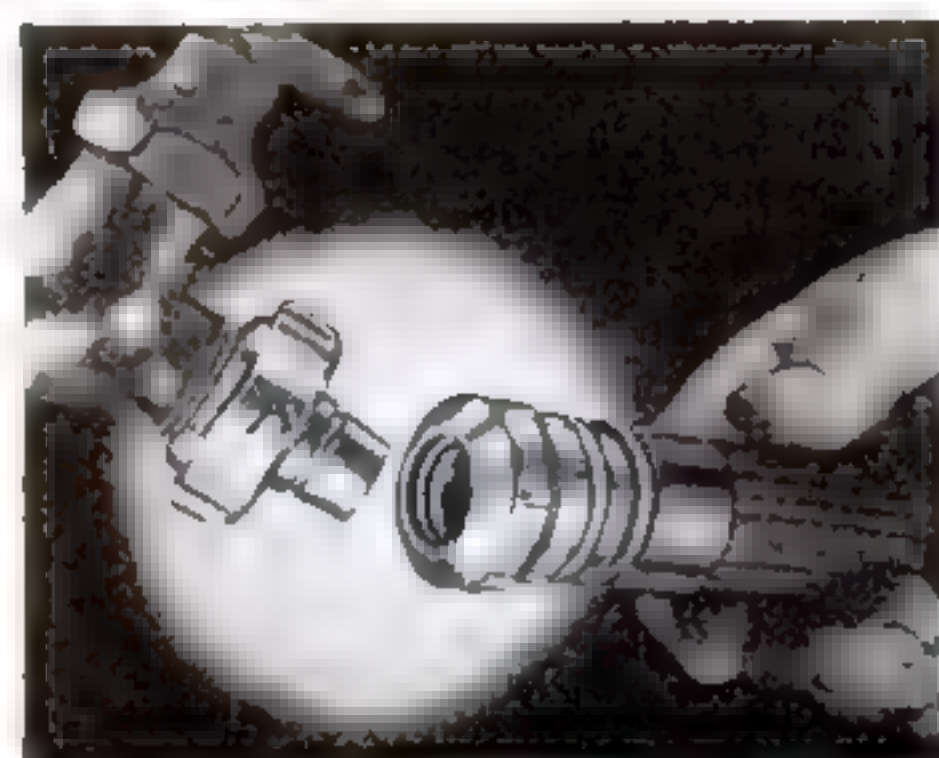
gallons of water a minute through four main outlets. A detachable extension ladder, carried on the roof, is mounted on large wooden wheels so that it can be moved about independently.

## VERTICAL BERRY PATCH AIDS PICKERS



Picking strawberries from vines growing from the sides of a novel bed

**STRAWBERRIES** grow horizontally above the ground in novel wooden boxes designed by a Florida farmer. Young plants, set into the soil through holes in the box sides, grow outward, making it possible to weed them and pick the fruit without stooping continually. The berries also are kept free from grit and sand while growing in this position.



## GARDEN-HOSE COUPLING SNAPS ON AND OFF

TO SIMPLIFY attaching a garden hose to a water-pipe faucet, a new spring coupling, pictured above, snaps on and off like a detachable cuff link. According to the maker, the device is easily and quickly attached to any standard threaded faucet, and is completely water-tight. The coupling connection operates on a swivel joint to prevent kinking.

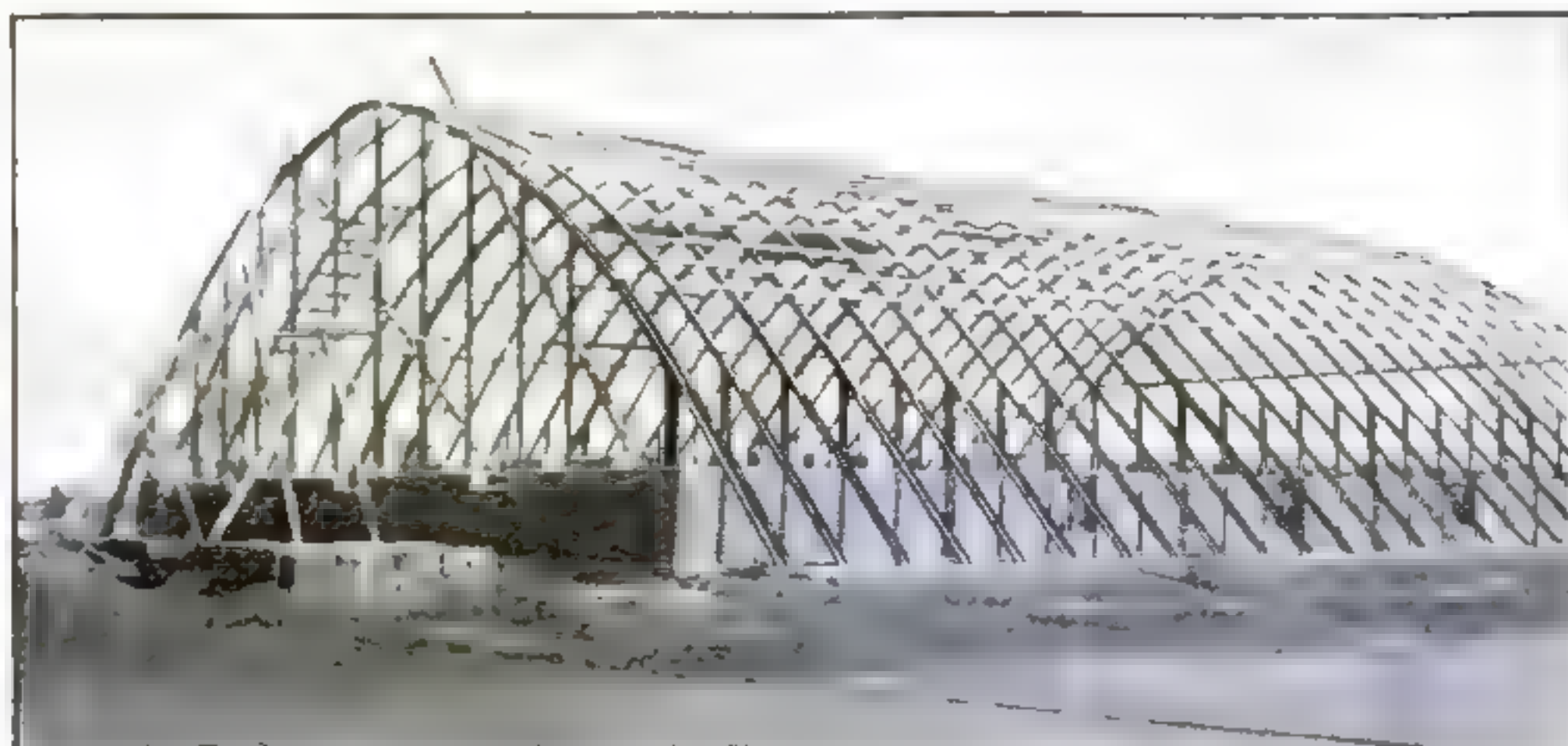


Old street-car rails being bent into shape to form the roof arches of a hangar. The ends are bedded in concrete at a forty-five-degree angle. At right, completed framework of hangar

## TROLLEY RAILS FORM ROOF OF HANGAR

**TEN THOUSAND** feet of junked street-car rails were put to practical use in constructing a novel airplane hangar recently erected at the Dixon, Ill., airport. Lengths of track, riveted to rails embedded in concrete at a forty-five-degree angle, were bent cold to form the

roof arches of the building. Side walls are reinforced by perpendicular struts of car rail, which also are based in a concrete foundation. No machinery other than a hoisting crane was used in erecting the framework or in bending the rails into wide-span arches.



# The Man



with the Net

EGGS are taboo in some sections of the Sudan. They are used only as an emetic.

MAN and the rat are the only animals that will eat any animal or vegetable foods.

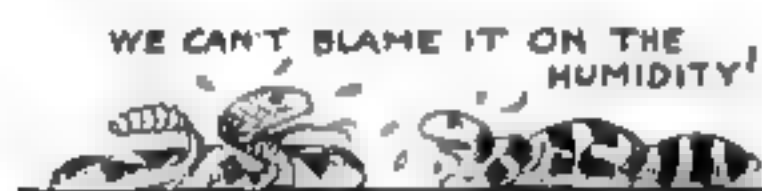
A WHITE OAK TREE in Georgia holds title to the land it stands on. It was bequeathed by its former owner.



THE LEFT HAND freezes more easily than the right.

THE DRAGON'S BLOOD TREE of the Canary Islands, noted for its great size and long life, is a member of the same plant family as the tiny and short-lived crocus.

RATTLESNAKES and Gila monsters die when exposed to the hot desert sun for a short time.



THE NILE has a greater variety of fish than any other river.

TWINS are most common in Denmark; rarest in Colombia.

THE BRIDAL VEIL is a survival, in abbreviated form, of an ancient custom designed to protect the bride from evil spirits.

ELEPHANTS have a more rapid pulse when lying down than when standing up.



A HUMAN HAIR has an average life of two years.

MAPS made of a pure vegetable parchment are stronger when wet than dry.

TAPIOCA is derived from a poisonous root—that of the manihot plant of tropical America.

A LAND SNAIL travels at a speed of about a mile a month.



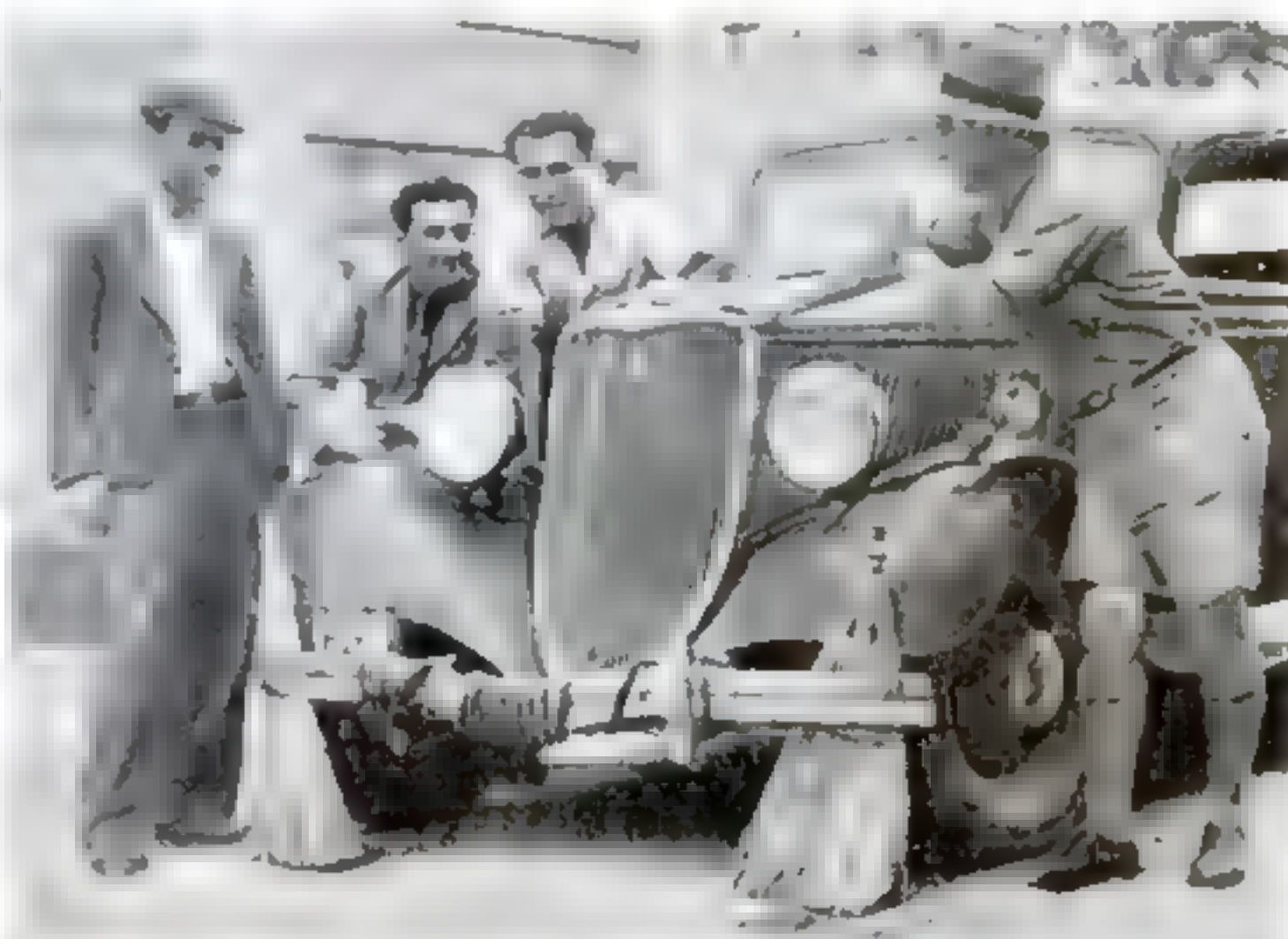
## WIND SCREEN SHELTERS SUN BATHERS

CONVENIENTLY carried to any desired spot, the transparent screen shown above protects beach loungers from wind and drifting sand as they acquire sun tans.

Spikes hold the screen upright on the sand while the flexible, transparent material admits the sun's ultra-violet rays and allows the users perfect visibility.

## BROOMS SWEEP NAILS FROM PATH OF CAR

TO PROTECT their tires against nails and broken glass strewn in the roads during recent disturbances, motorists of Jerusalem fitted their cars with large brushes. Attached to bumpers in front of the wheels, the improvised guards, looking like magnified whisk brooms, sweep sharp objects clear of the tires.



This Palestine motorist takes no chances with nails on the highways

## JACKS RAISE AND LOWER SCAFFOLDING

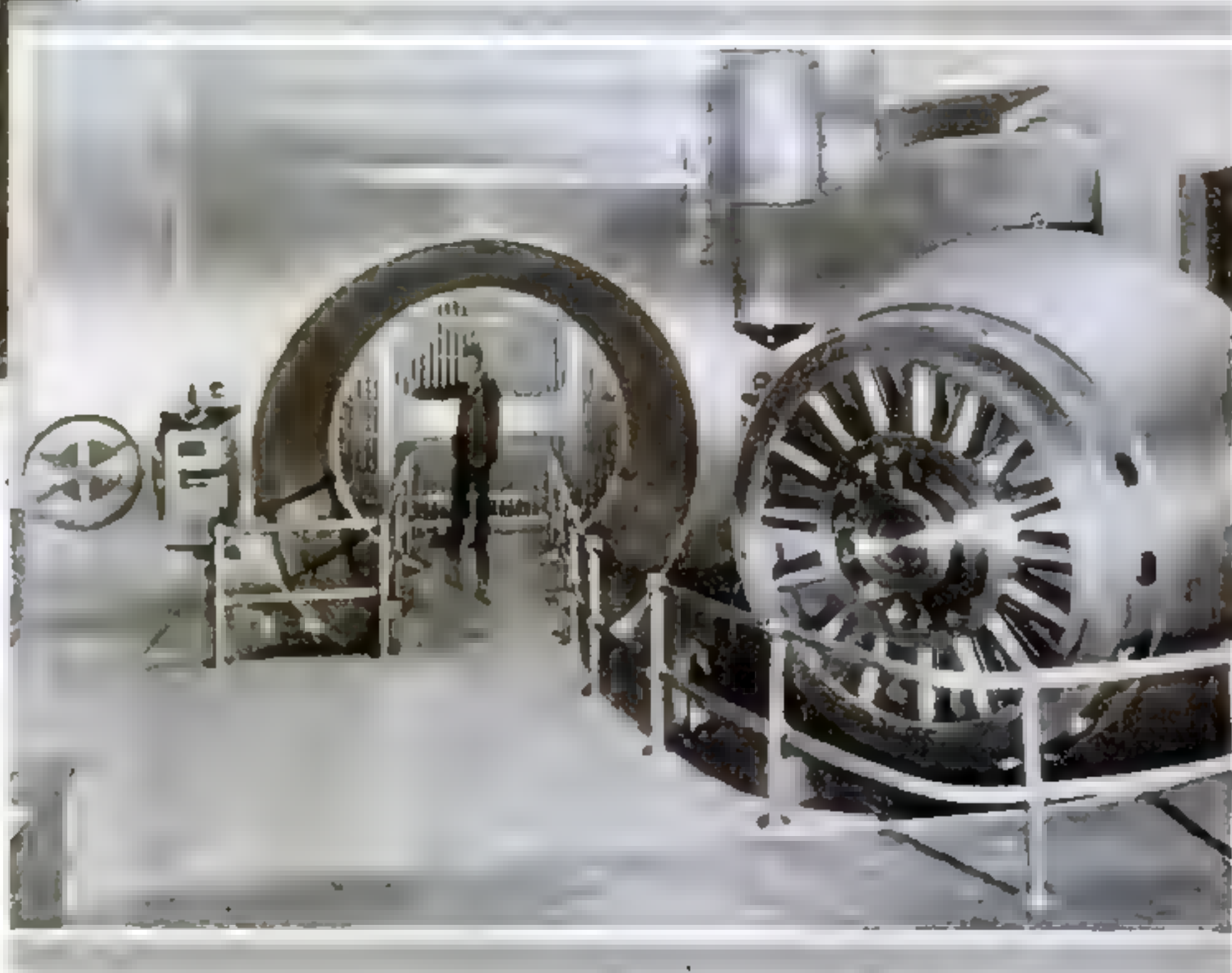
HAND-OPERATED lifting jacks raise or lower a scaffold recently marketed for use by painters, decorators, and masons. Supported on a wooden frame, the elevating working platform rides up or down on a vertical cog track as workmen turn the jack handles. The scaffold frame can be rolled from place to place on its ball-bearing casters, and is assembled with bolts and wing nuts so that it can be quickly set up or dismantled in moving from one job to another, eliminating the necessity of building a new scaffolding at each location.



Painters operating jacks to raise the novel elevating scaffold

# Newest Bank Vaults

## DEFY THE CRACKSMAN



The forty-eight-inch circular vault door of the Federal Reserve Bank at Cleveland, Ohio, swung open. Even the searing flame of the oxyacetylene torch (left) is balked by modern vault construction

By  
**ROBERT E. MARTIN**

**T**O STORE the gold reserve of the United States Treasury, a masterpiece of the vault maker's art is nearing completion at Fort Knox, Ky. Within a steel-and-concrete fortress anchored in solid rock a steel chamber suspended like a chandelier will accommodate as much as nineteen billion dollars worth of precious yellow bullion, and guard it from fire, flood, earthquakes and the depredations of master criminals. Experts say the contents will be safe even in the event of insurrection or the temporary invasion of a foreign army. It would take expert cracksmen a month to bore and blast their way through to the interior.

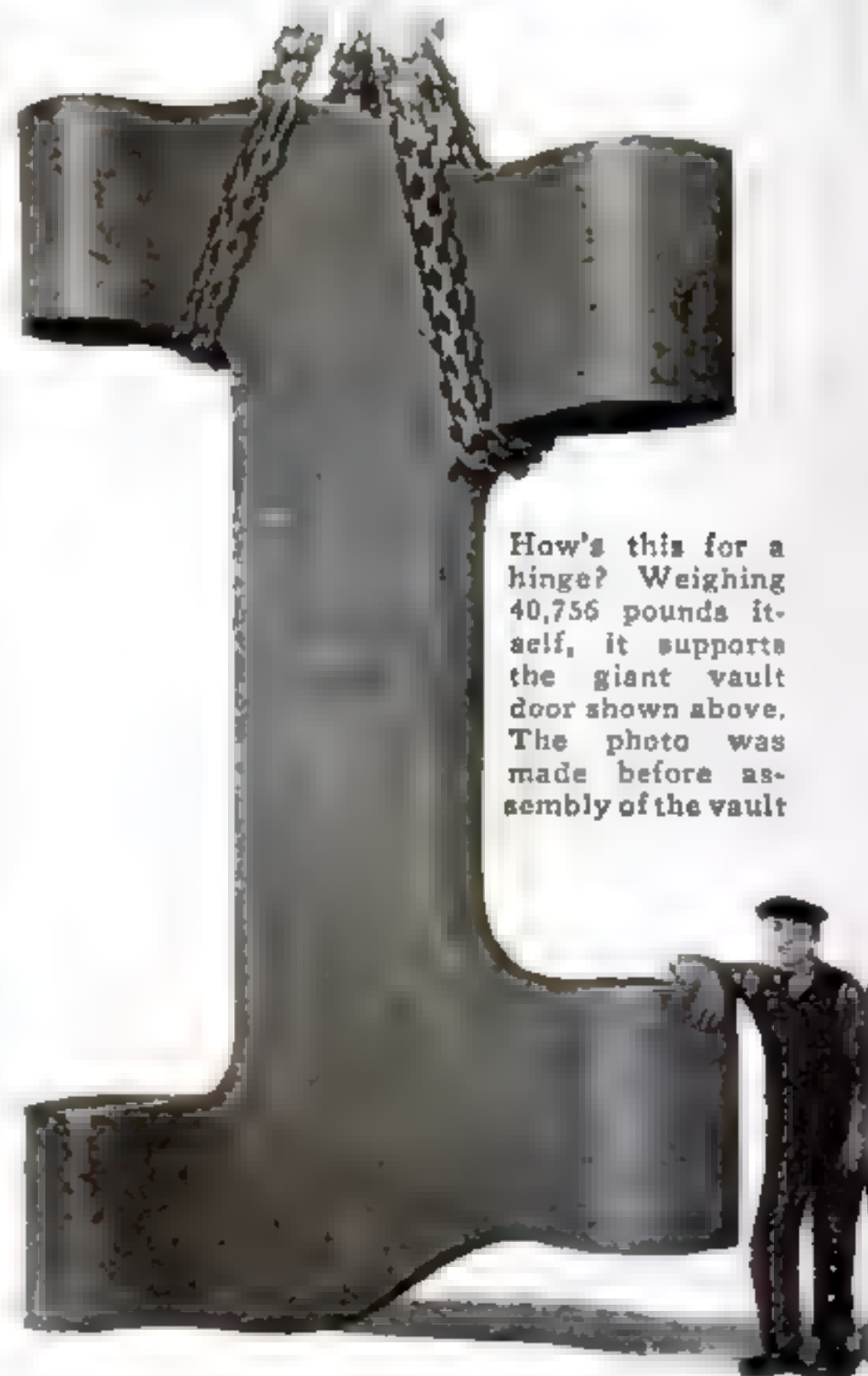
Behind this and other modern strongholds for valuables lies an exciting story. The race between vault makers and vault breakers has been compared to the contest between makers of armor plate and of guns to pierce it. Only recently have the guardians of the nation's wealth in Government institutions and private banks, appeared to gain the upper hand.

When you put your money, your securities, or your jewels in an up-to-date bank vault, you are intrusting them to the safest repository that science has been

able to devise. Walls that release noxious gases when tampered with, steel alloys that can withstand the flame of a cutting torch for ninety-six hours, and sensitive electric alarms that detect the faintest sound of tunneling or vault-breaking, are among the latest weapons against cracksmen. They are the outcome of lessons taught by the boldest of criminals.

Incredible as it seems today, yeggs once broke into a New York savings institution and looted it of more than \$2,700,000—the largest haul in the history of bank robbery. They worked with explosives and tough drills, and when they departed they left behind one of the finest kits of vault-breaking tools ever assembled. Experts valued it at \$3,000.

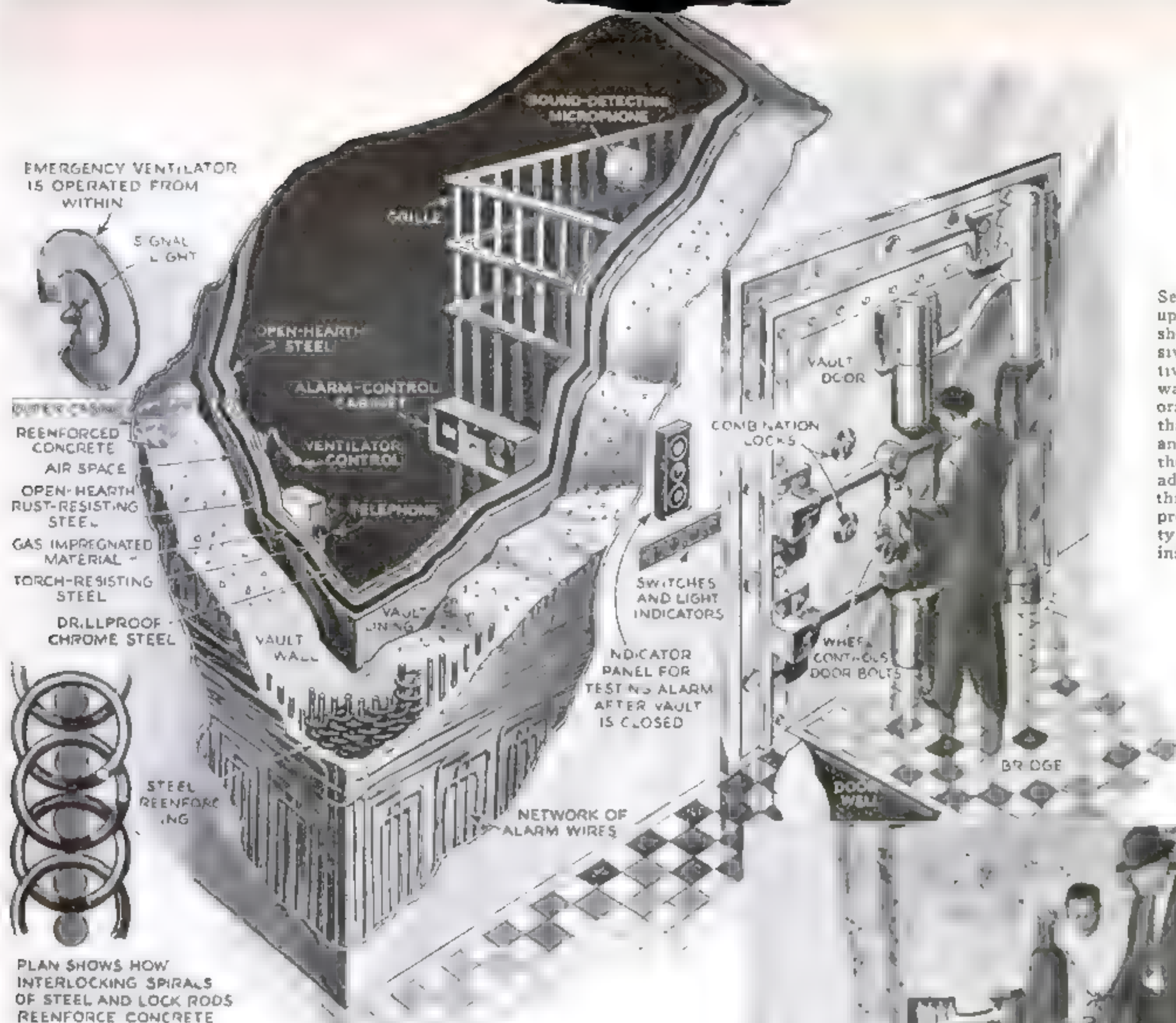
That was in the seventies, and it showed that criminals were on their toes to take advantage of every scientific development. It was only a short time before, in 1866, that safe-blowing was invented. Earlier cracksmen had been content with picking old fashioned locks, or getting past combination locks by kidnaping some luckless cashier or clerk and forcing him to reveal the combination. Then Langdon W. Morse, notorious outlaw and king of all cracksmen, devised a startling new technique. He drilled a small hole near the handle of a vault door, poured in a stiff charge of blasting powder, covered the spot with a



How's this for a hinge? Weighing 40,756 pounds itself, it supports the giant vault door shown above. The photo was made before assembly of the vault

blanket or rug, and lit the fuse. No door could withstand such an explosion, and the rest was simply a matter of scooping up the valuables.

Vault manufacturers met that challenge



Sectional view of an up-to-date bank vault, showing the successive layers of protective material in the walls and the elaborate system of alarms that give warning if anyone tampers with the walls or door. In addition to repelling thieves, the vault also provides for the safety of persons locked inside by accident



Through this hole, safe-crackers gained entrance to an old-fashioned vault from a rented room immediately above it in a California city

by developing casehardened, drillproof steel. Then the underworld countered with nitroglycerin, and the safe-cracker became the "soup yegg." Vault doors at that time were never quite tight. Crooks learned that by improvising a small cup out of soap, clapping it to the crack around the door frame, and pouring in the nitroglycerin or "soup," they could blast their way in as easily as before.

The oxyacetylene cutting torch added to the woes of the vault builders, and gradually it displaced nitroglycerin. Yeggmen were pleased at the way the torch flame sliced through layers of tough steel as easily as a hot knife through butter.

To this day, there is still no known metal or combination of metals that is completely torchproof, and no vault that has even been built is entirely invulnerable. Given the time and the tools, a competent crook can bore through the thickest and toughest barriers that man can devise.

Unfortunately for the cracksman, however, modern bank vaults don't give him the time. The clever bank looter today attacks old, outmoded installations and gives recent ones a wide berth. He realizes that long before he could gain entrance, an alarm would be sounded and he would find himself staring into the grim, cold muzzles of a dozen police revolvers.

Take a look at an up-to-date vault door. A flick of the wrist and a turn of the hand will start 200,000 pounds of circular door swinging shut on a gigantic hinge that weighs, complete with fittings, more than 70,000 pounds. It's like moving twenty-

five coal trucks, each loaded with four tons of coal, with a wave of the hand. Closing it is easy—but getting it open again, if you haven't any business there, is something else.

No unauthorized person has a chance, even, of unlocking it. As many as five separate time locks, run by clocks as accurate as a fine watch, guard the modern bank-vault door. Even if a bank employee or customer is accidentally locked inside—a remote possibility but an actual one—no one can possibly open the vault before morning to release the luckless prisoner.



Robbers held a family captive in the room above while they cut this hole into a vault

What happens then? Imagine the sensations of a person caught inside a vault at closing time as the huge door swings shut, time locks click, lights snap off, and the unfortunate prisoner finds himself locked in a sealed dungeon of steel. Groping his way along the cold, steel wall, in the inky blackness, he falls a prey to terrifying thoughts. Will the air hold out until he is released? Can a person suffocate in one of these murky tombs?

Suddenly, he sees a dim light, a ghostly glow that grows stronger as his eyes become accustomed to the darkness. Cautiously he approaches. There on the vault wall, in gleaming letters of luminous paint, he finds explicit instructions directing him to turn a near-by lever. Instantly a bright light flashes on, and an emergency ventilating system goes into action, blowing welcome streams of fresh air into the vault through a sectional steel plug in its wall. The prisoner will be none the worse for his experience when he is rescued.

In the *(Continued on page 102)*

## Dummy Gives Safety Test to Drivers



Hidden by a parked car, a tester catapults the lifelike dummy, shown at left, into a driver's path



**A** LIFELIKE dummy, dressed to represent a boy, darts in front of oncoming cars in experiments devised by a large New York corporation to test its drivers. A safety crew, stationed behind a parked automobile, catapults the dummy "victim" on rollers into the path of a company car. The tests provide data on the relative speed of drivers in reacting, and impress on them the need for caution.



Indoor golfer "teeing off"; a light in the tall case will show result

## INDOOR GOLF USES LIGHTS FOR SCORING

**WHEN** the player in a new variety of indoor golf drives a "captive" ball, a light travels along the plan of a golf course, in the tall case seen above. Colored lights, red for one player and white for his opponent, show how far the shot has gone, and whether it is on the fairway, out of bounds, or in a bunker.

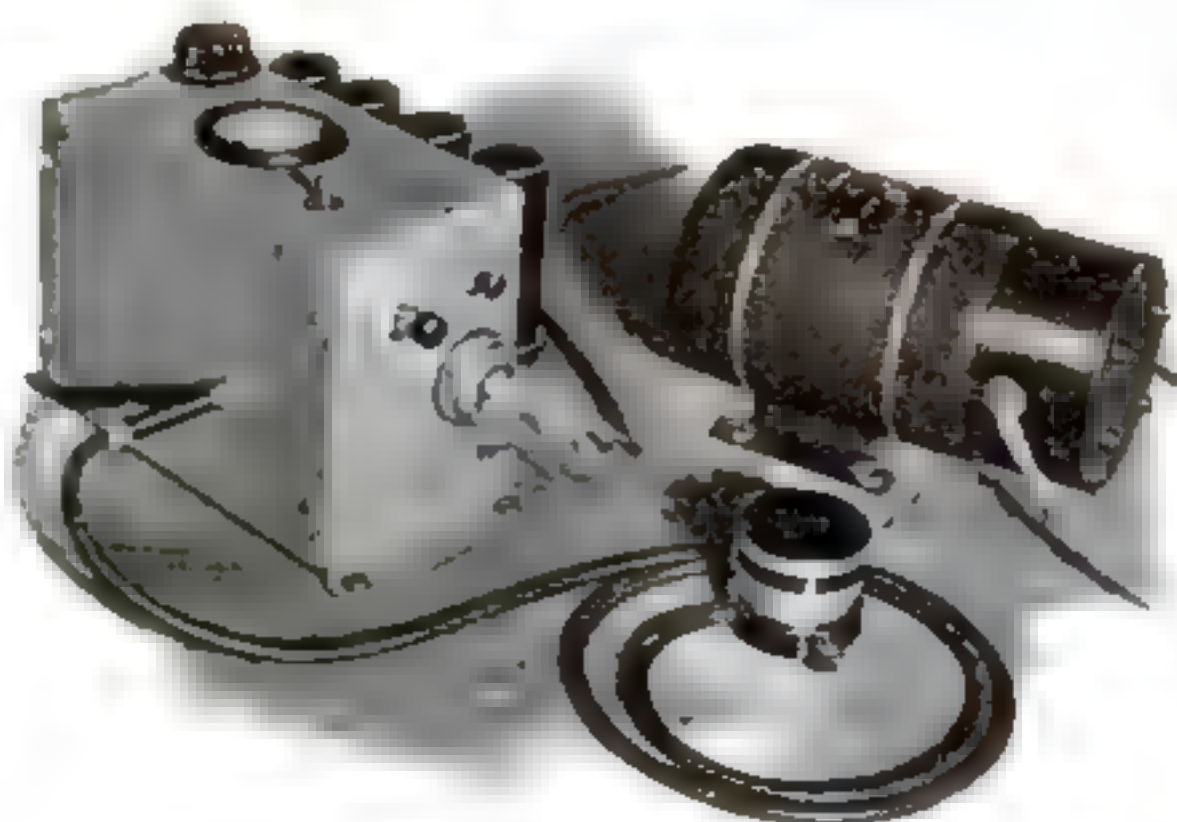


## ANTISEPTIC SOLUTION MAKES CLOTH GERMPROOF

**APPLICATION** of a liquid preparation which renders cloth antiseptic and germ-proof may greatly reduce the dangers of infection from articles in common use, such as towels and laundry. The new process not only destroys any germs that the article possesses at the time of treatment, but also, it is claimed, any that may come in contact with it later. The solution is colorless and odorless, and the antiseptic power lasts indefinitely.

## HANDY OILER WORKS LIKE FOUNTAIN PEN

**A** HANDY precision oiler, resembling a fountain pen, reaches places that would be inaccessible to the ordinary oil can. Pressure on the steel point releases a drop of oil wherever it is needed. The oiler is leakproof and has a pocket clip for convenient carrying.



"One-drop" oiler, showing visible oil supply and method of applying

## PRIVATE-PLANE PILOTS GET LIGHT RADIO TRANSMITTER

**COMPACT** and simple to install, a lightweight transmitting unit for private planes and small airliners can readily be installed within reach of the pilot. Unlike many midget transmitters, which have a very limited range, this outfit, with its small current consumption, has worked well at distances over 100 miles. The unit can be mounted in front of the control column, under the seat, or on the dash, and the pilot can adjust the transmitter to compensate for variations in the length of the trailing antenna. Complete with dynamotor, or power pack, as illustrated above, the transmitting outfit weighs less than seventeen pounds.



Inserting the cooling grid in the pipe bowl

## METALGRID MAKES PIPE SMOKE COOL

**COOLER** smokes for pipe users are provided through a metal grid which can be inserted in the bowl of the pipe. Made of a tight coil of spring wire, the grid conducts heat away through the metal, and prevents stray bits of tobacco from entering the shank of the pipe. The coil also keeps tobacco out of the soggy "heel" of the pipe, and thus produces better burning.

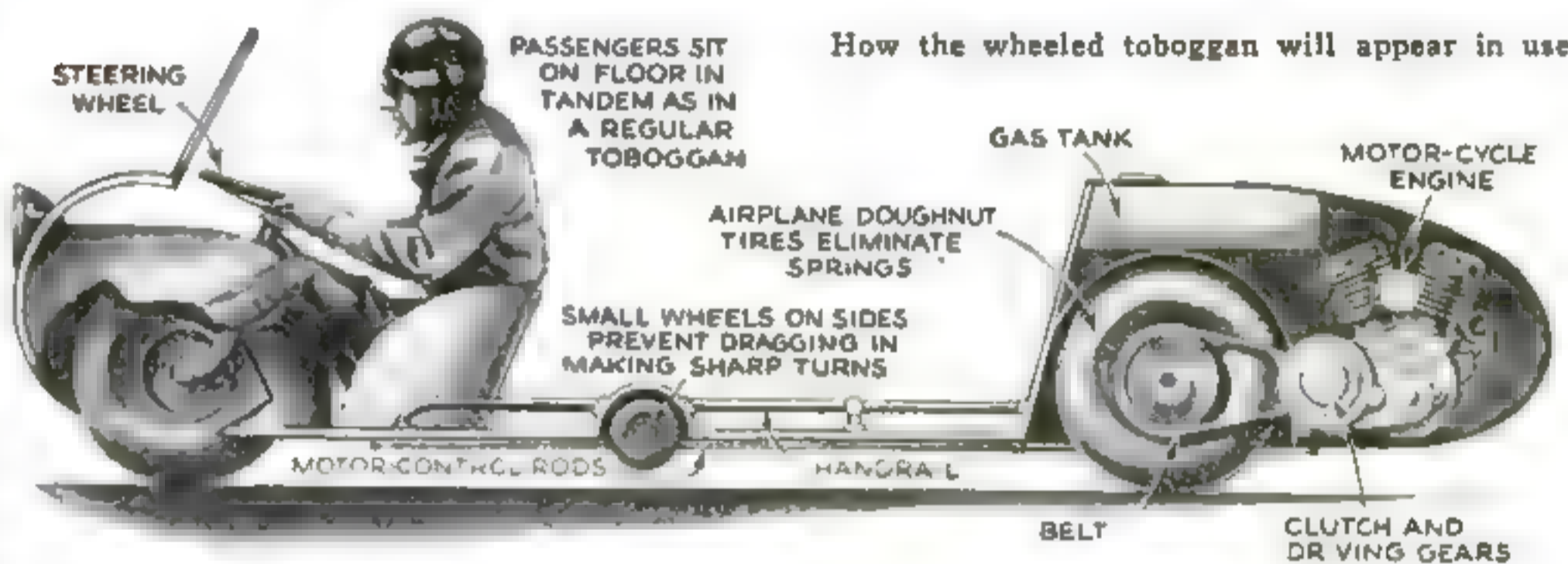


### RADIO TRANSMITTER IS COMBINED WITH CAMERA

Called a "photo-mike," a mobile broadcasting unit, pictured above, combines a still camera and an ultra-short wave radio transmitter. Used at meetings and conventions to make "candid" shots of speakers while picking up their voices, the novel apparatus utilizes a three-tube, battery-operated transmitter to relay the voice to a central control room for amplification and rebroadcasting. Antenna wires are concealed in the tripod supporting the "camera-radio." An automatic flash-bulb attachment provides the light.

## ROAD TOBOGGAN GIVES THRILL RIDE

POWERED by a motor-cycle engine, a novel highway toboggan proposed by a California inventor seats four to six persons and is expected to reach a top speed of ninety miles an hour. Stamped out of aluminum alloy, the springless, sledlike frame is supported on two airplane-type doughnut tires. Riders sitting in tandem fashion behind the driver grasp aluminum hand rails attached to the side of the frame. The odd vehicle, according to present plans, will have a six-foot wheelbase and an overall length of eleven feet. Operating levers near the auto-type steering wheel are attached to long metal rods leading to clutch, spark, gas, and brake controls. Small auxiliary wheels at the side of the frame keep it from dragging in rounding sharp turns. The two-cylinder engine is mounted at the rear of the toboggan and drives the single rear wheel through a belt arrangement.



How the wheeled toboggan will appear in use

This drawing shows the construction of the novel vehicle, and arrangement of power and control units

## DEATH RAY FOR GERMS IS PRODUCED BY NEW VAPOR LAMP



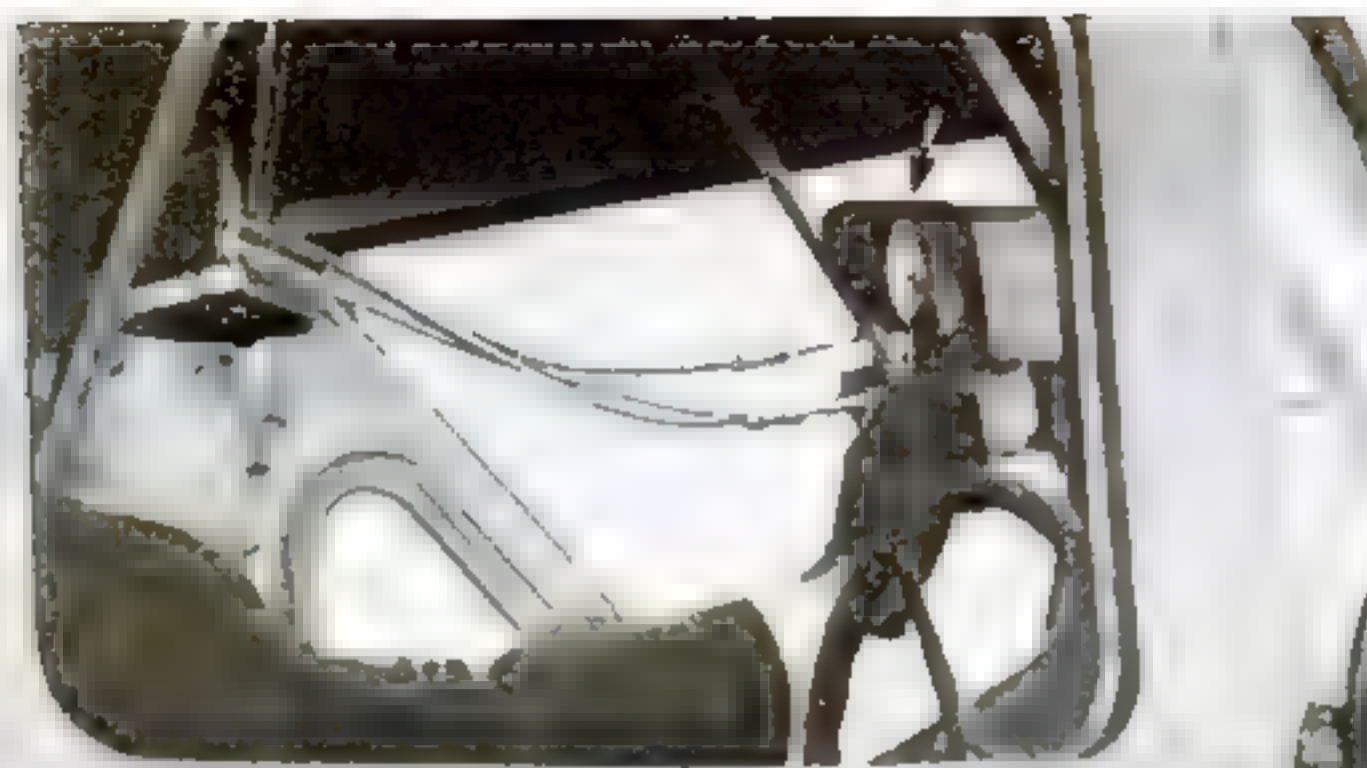
A research expert examining some of the shapes into which the new germicidal lamp can be made

ELECTRIC CURRENT surging through a slender glass tube filled with a special gas produces germ-killing rays that destroy mold and bacteria, according to a recent announcement by scientists of the Westinghouse Lamp Company, Bloomfield, N. J. Developed after nine years of research, the germicidal lamp is expected to control the microorganisms which are primarily responsible for the annual loss of millions of dollars through food spoilage. Under the lethal rays, fresh meat can be aged or "tenderized" at much higher temperatures than at present, thereby effecting large savings in refrigeration

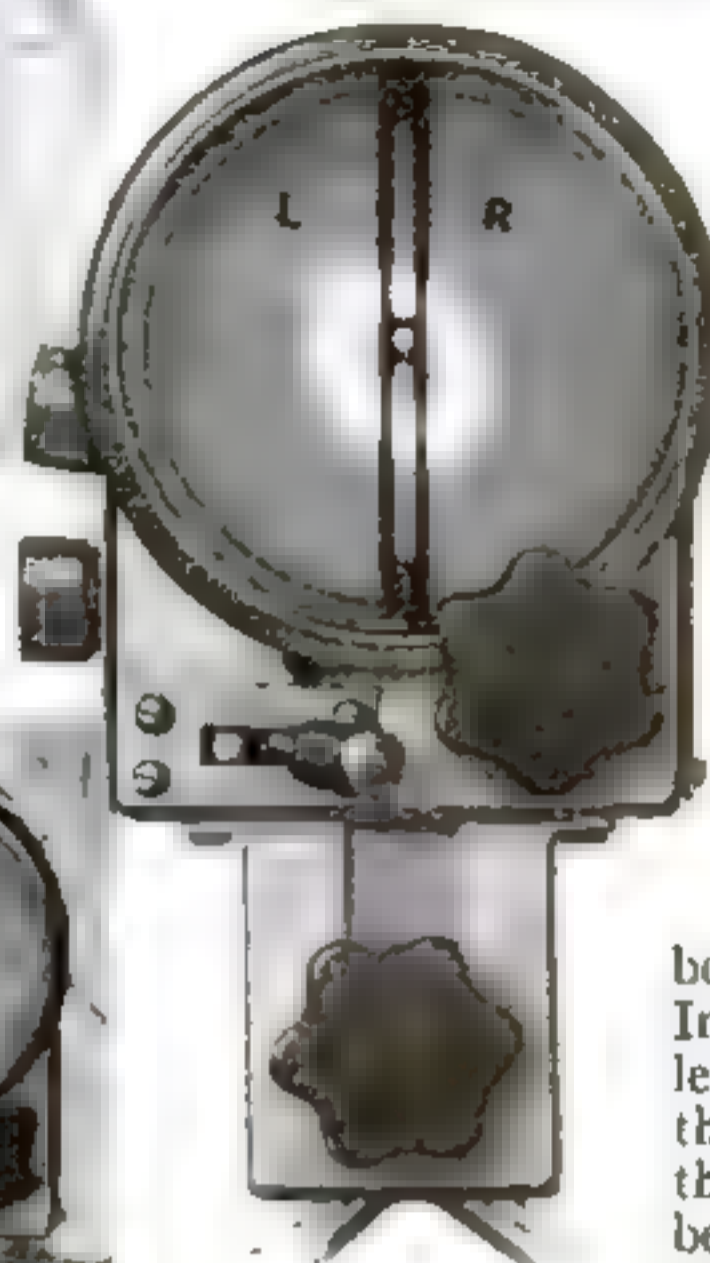
costs, speeding up the process, and reducing the retail price of meat. When tested in a large bakery, the ultra-violet radiations practically eliminated the mold growths that cause the spoiling of fruit cakes. Suspended over the operating table in the Duke University medical school at Durham, N. C., the lamps are used to sterilize the surrounding air and so guard against infection.



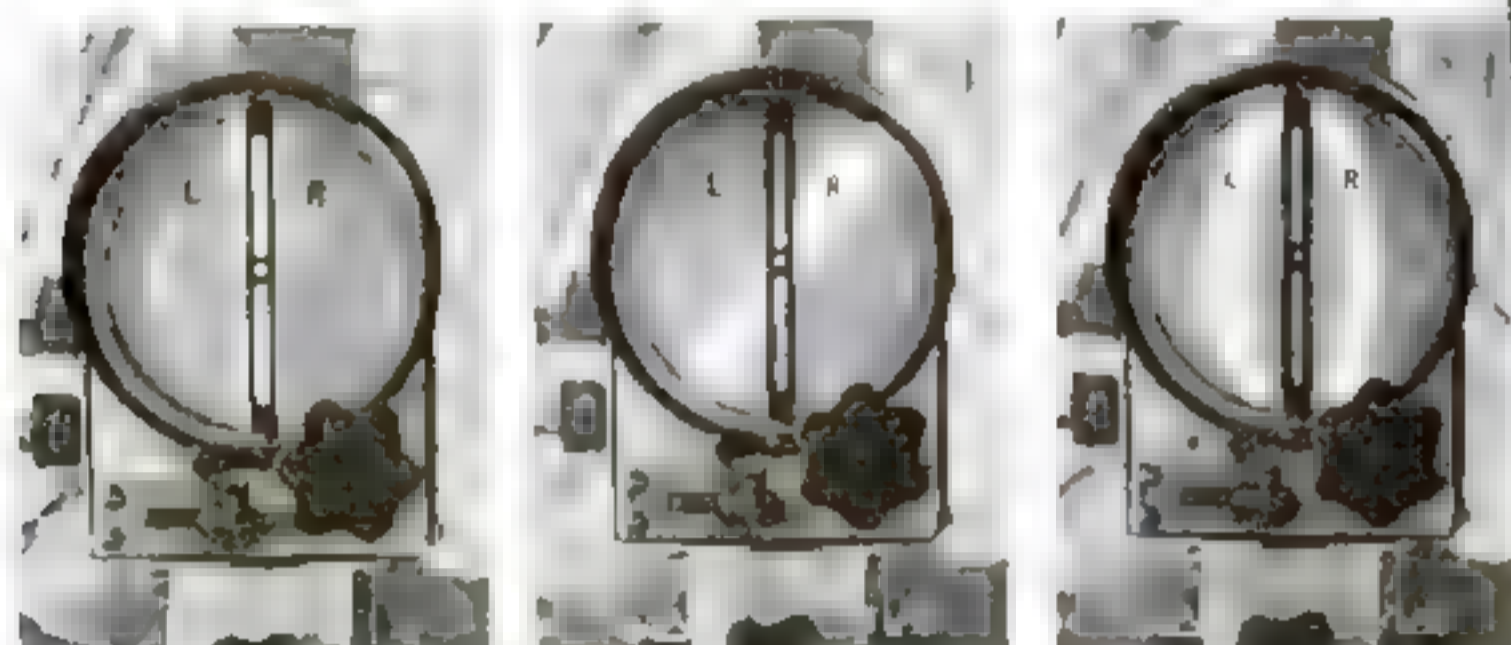
Left, bacteria-killing lamp units suspended over the operating table at the Duke University medical school, Durham, N. C. Above, surgeons in protective hoods and glasses



This visual direction finder installed in a Coast Guard plane, and, at right, how the beam looks when the plane is over the station



**VISUAL** radio-beam direction finders for airplanes may replace the audible types now in general use, if U. S. Coast Guard experiments with a new cathode-ray "eye" prove successful. Powered by the plane's regular storage batteries, the apparatus includes a directional antenna and a small "viewing screen" mounted above the cockpit instrument panel. When the antenna is adjusted to pick up signals from an airport radio transmitter, a light shows on the screen. If the plane is directly on the course to the airport, the light appears as a vertical beam back of perpendicular guide lines. Inclination of the beam to the right or left indicates that the plane is flying to the right or left of the straight course. As the craft approaches the airport, the light beam splits and fans out into an ellipse; when directly over the airport transmitter, it forms a circle in the center of the screen, as shown in the illustration.



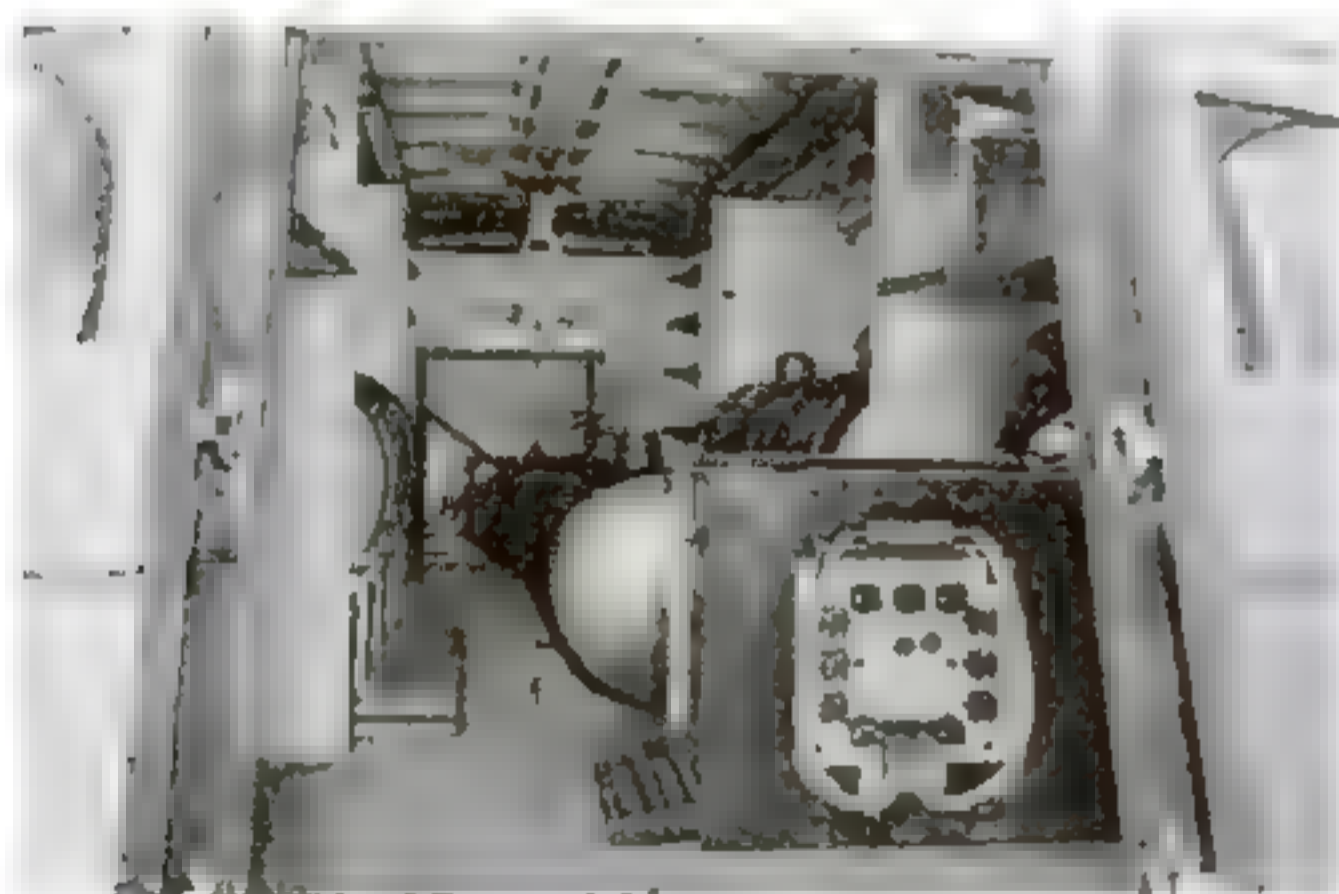
In the photos above, the vertical beam, left, shows the plane to be on its course; the inclined beam, center, that it has veered to the right; the split beam, that it is near the station

## ELECTRIC MARKING TOOL HAS VIBRATING CUTTER

**MATERIALS** such as glass, plastics, and fiber, as well as hardened steel, can be marked with this recently developed electric tool. As the marking is done by the rapid vibration of the hardened point rather than by an electric arc, it can be used on nonconducting materials.



## PROSPECTORS USE MOBILE LABORATORY



Interior of the specially built truck which carries equipment for locating and assaying samples of ore in the desert

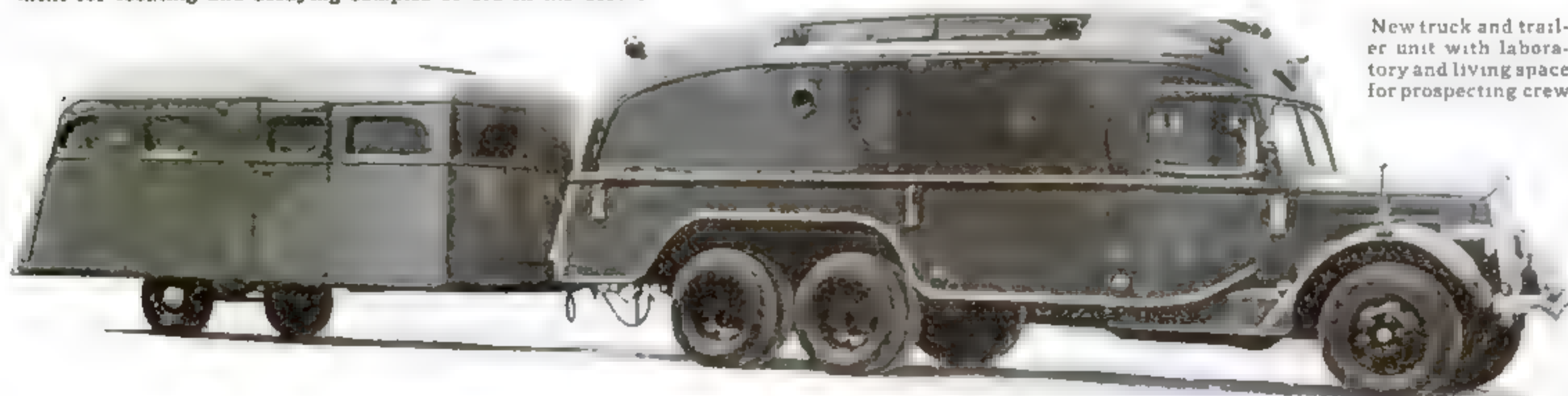
**SCIENTIFIC** prospectors, now searching for precious metals in the Southwest, are using a specially constructed truck and trailer which provides both living quarters and a completely equipped laboratory for testing ore samples. The powerful truck has a four-wheel drive, eight speeds, punctureproof tires, air brakes, and five gasoline tanks. Beds, refrigerator, and cooking equipment are in the trailer, while the truck houses an assay furnace and other equipment.

## SQUARE BLADE GIVES RAZOR FOUR EDGES

**FOUR** cutting edges instead of the usual two distinguish the blades in a new type of safety razor just invented. The blade holder is square, with a hinged top that swings up instead of lifting off. Blades are made in four separate sections and held together at the corners by a small frame. The inventor claims that the blades will last twice as long as the conventional double-edged type.

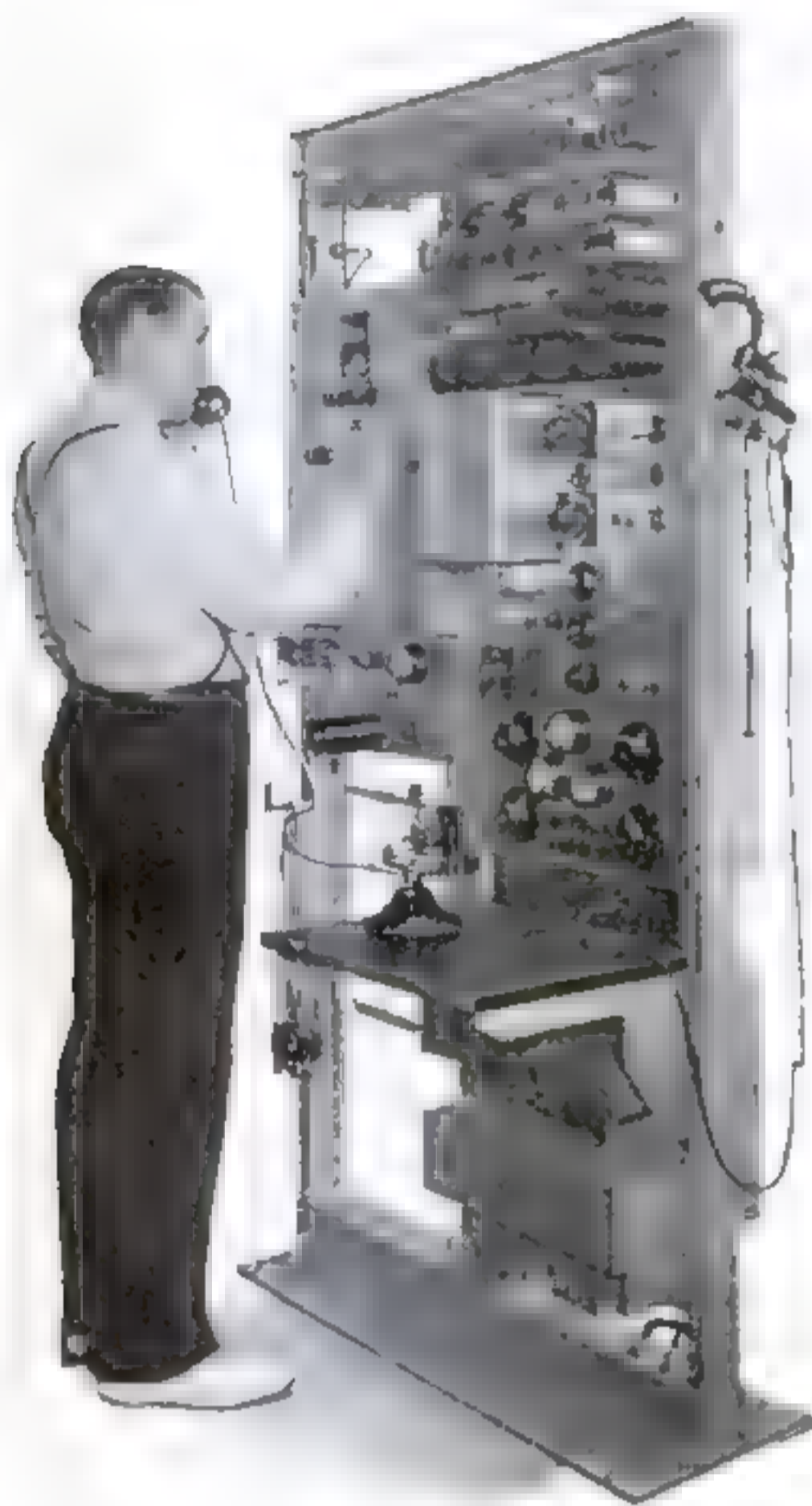


Four cutting edges give longer life to this razor blade, which fits into a square holder

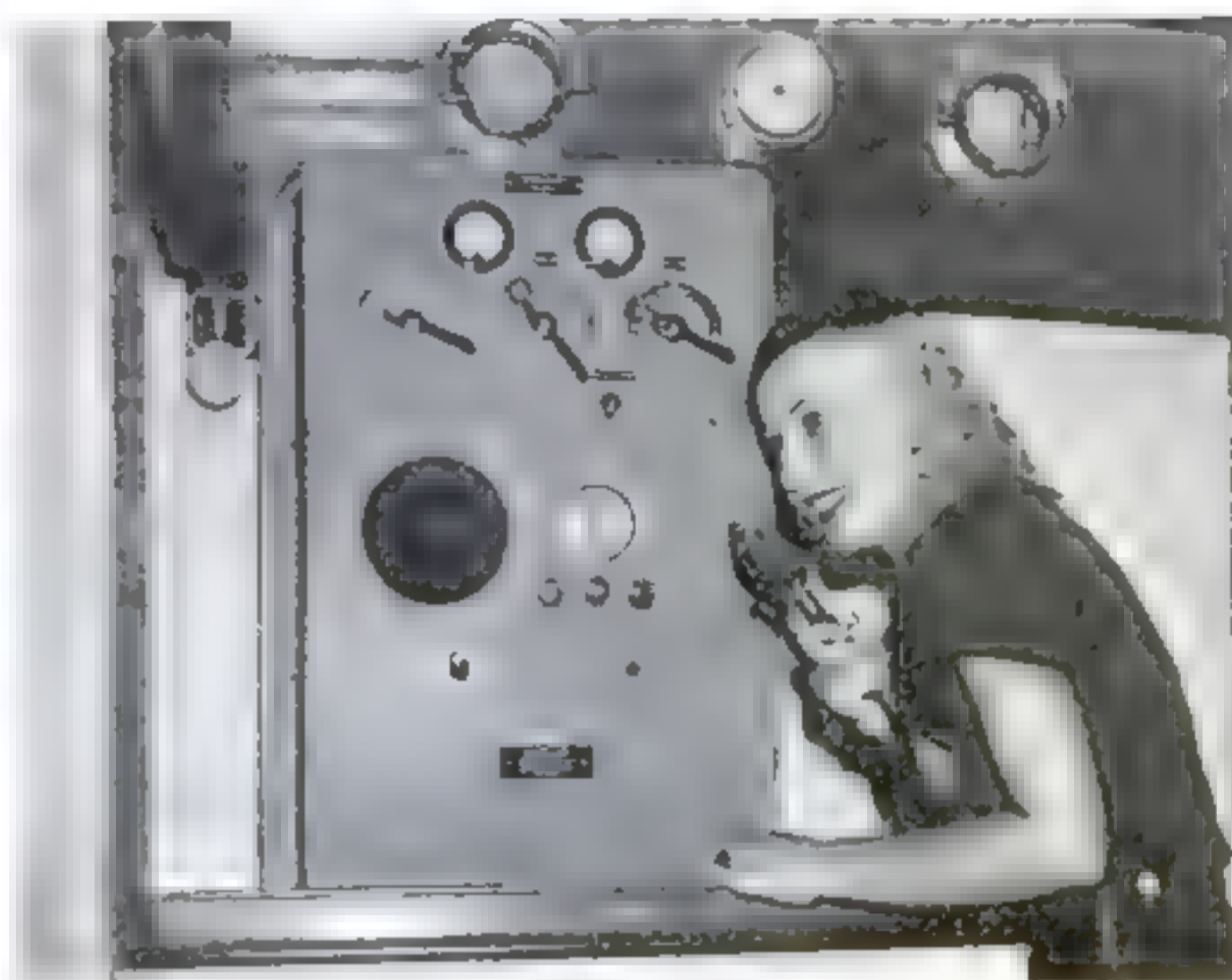


New truck and trailer unit with laboratory and living space for prospecting crew

# Small Boats Get Phone Calls by Radio



Switchboard of shore connecting station that links small-boat radios with telephone lines



A yacht passenger making a telephone call to shore  
At right, the radio station that relays the messages



**R**ADIO-EQUIPPED fishing boats, pleasure yachts, and other small craft on the Pacific Ocean near Los Angeles, Calif., can now talk to all shore points through a new radio station which connects with telephone lines. Radio operators on the boats call KOU, the connecting station on shore, and give the telephone number they desire. The shore operator calls the number, and connects the telephone line with his transmitting and receiving apparatus. Speech is thus carried over regular telephone lines to KOU, and thence by radio to the boat. The radiotelephone connect-

ing station also serves as a radio beacon to guide vessels through fog or storms. Similar installations are being made at San Francisco, Calif., and Seattle, Wash.

## TWIST OF HANDLE TURNS COPING-SAW BLADE

**A**N **INGENIOUS** chain-and-cogwheel arrangement mounted on the frame of a new fret or coping saw enables the user to change the cutting angle of the blade while it is in motion. The piece to be cut is held in a vise, while one hand operates the saw blade and the other holds the frame in the most advantageous position. A twist of the handle turns both ends of the blade simultaneously.



Chains and cogwheels turn the blade of this novel fret saw to change the cutting angle



## SPARE PARTS MAKE TOY TRACTOR

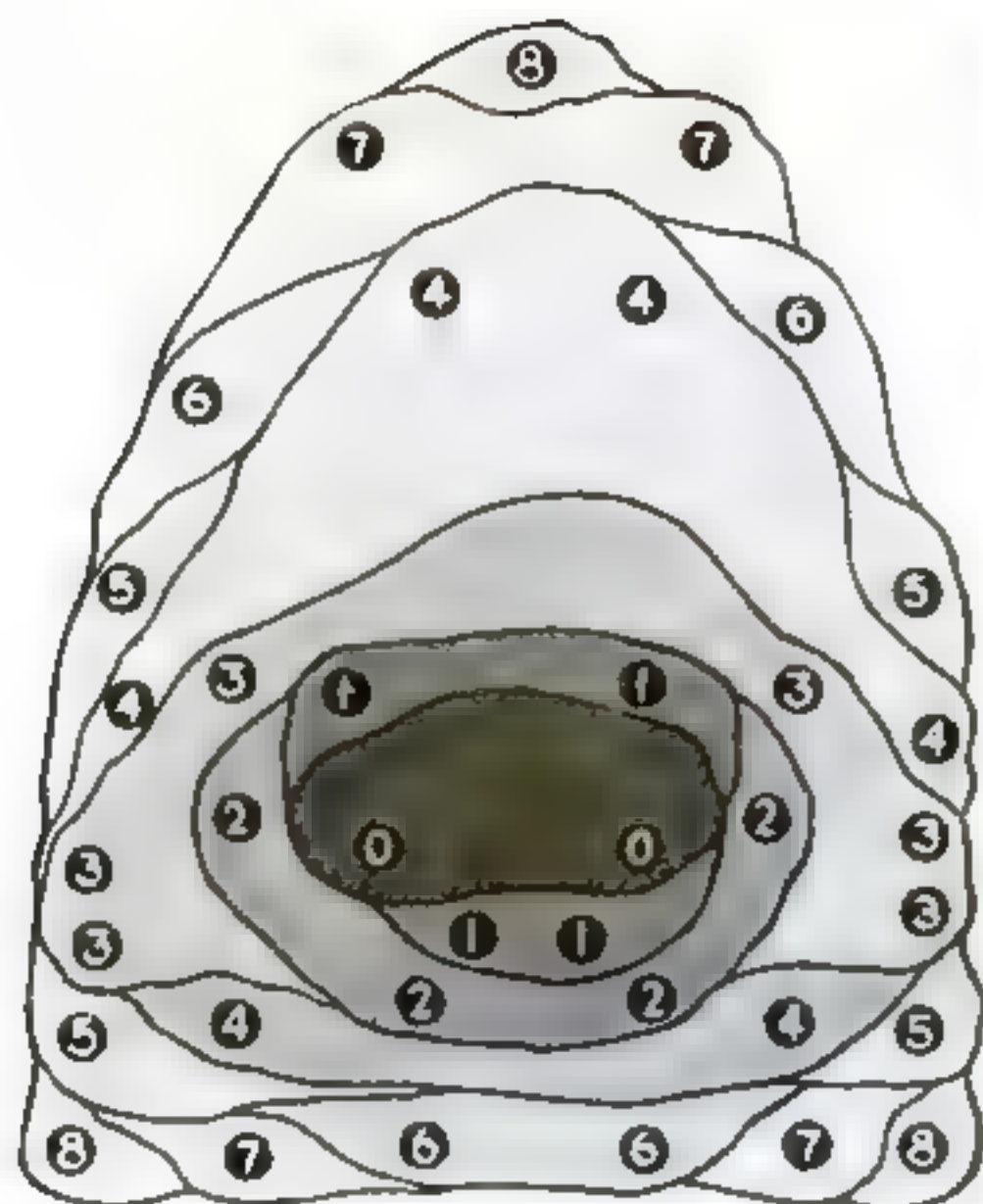
**S**PARE auto parts, a reconditioned gasoline engine, and old wagon wheels were combined by a Californian to construct this diminutive tractor. The frame and axles of a junked auto were shortened to serve as the tractor chassis, and the 1½-horsepower engine is geared to the differential and drive wheels by two transmission units, installed in tandem.

## ODD GUN SHOTS CHEMICAL TO KILL DANDELIONS

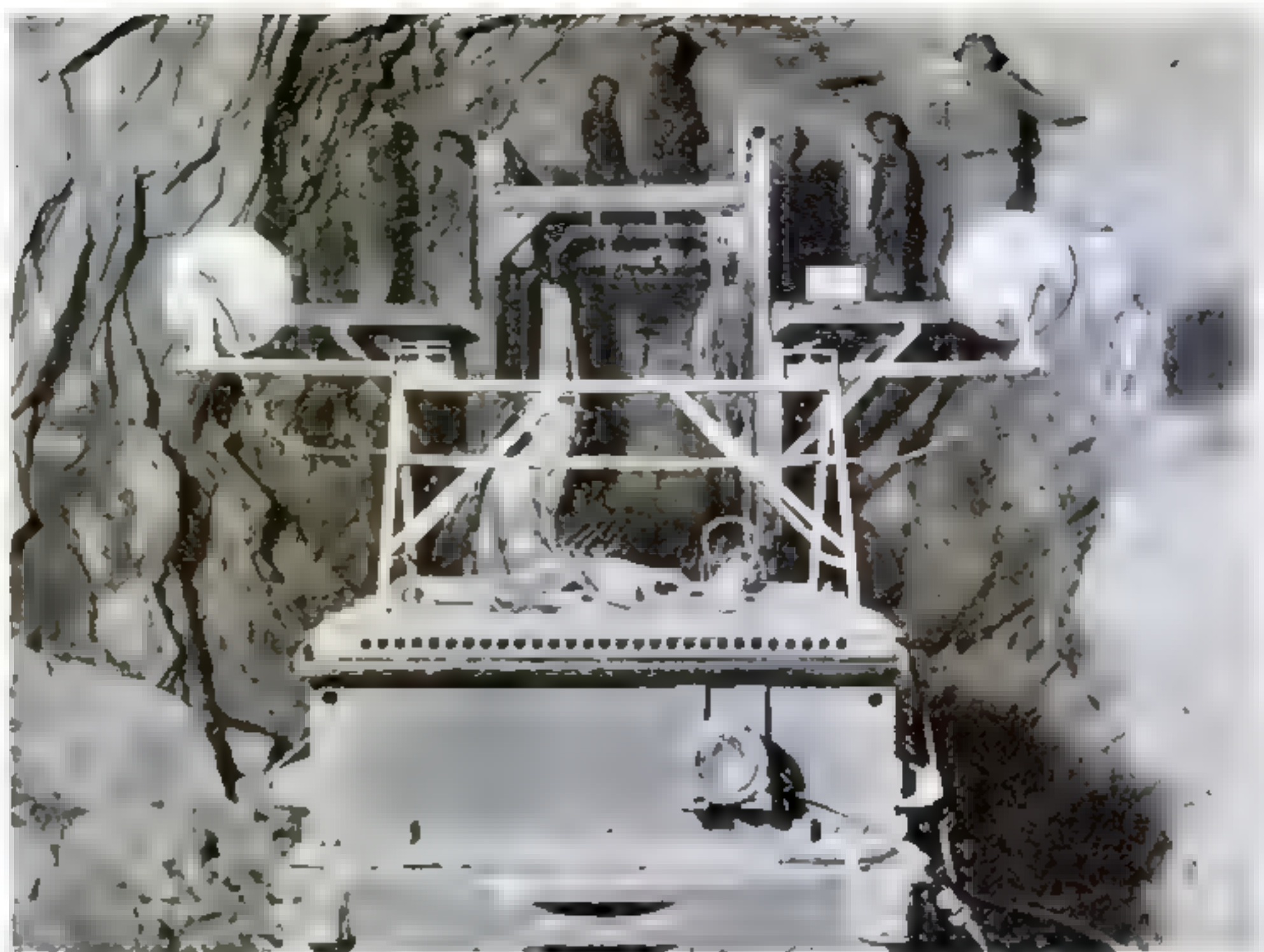
**D**ANDELIONS are quickly and easily eliminated from lawns by a chemical applying device recently marketed. When the user pulls a small trigger near the end of the wooden handle, a dab of powder is expelled onto the weed from a metal container. Chemicals in the powder draw the moisture from leaves and roots, causing the weed to dry up and die within a short time after the application.



A pull on the trigger at the end of the handle ejects a powder to kill dandelions



At right, workmen on the platforms of a "jumbo" are drilling the thirty-seven or more holes required for a blast. The drawing above shows how groups of charges, exploding at one-second intervals, blast the rock roughly to the size and shape desired for the tunnel



# Rapid-Fire Blasting

## SPEEDS GREAT AQUEDUCT TUNNEL

**B**URROWING beneath mountains for more than a fourth of its 392-mile length, the great Colorado River Aqueduct system, projected by Metropolitan Water District engineers, is rapidly nearing readiness to carry a billion gallons of water daily to Los Angeles and neighboring communities of southern California. Tunneling records of the past are falling as toiling crews push forward thirty-seven tunnels, totaling a distance of 108 miles, that will be vital links in the mighty engineering undertaking.

Until a few years ago, a crew of miners could shoot only one "round," or blast, breaking down four and a half feet of rock, in a single shift of eight hours. In some of the Colorado River Aqueduct tunnels, however, it is not uncommon for a twenty-man crew to shoot three five-foot rounds. Recently, in three shifts, ten rounds were shot and the Seven Palms tunnel advanced fifty-five feet in one day—a world's record in rock tunneling.

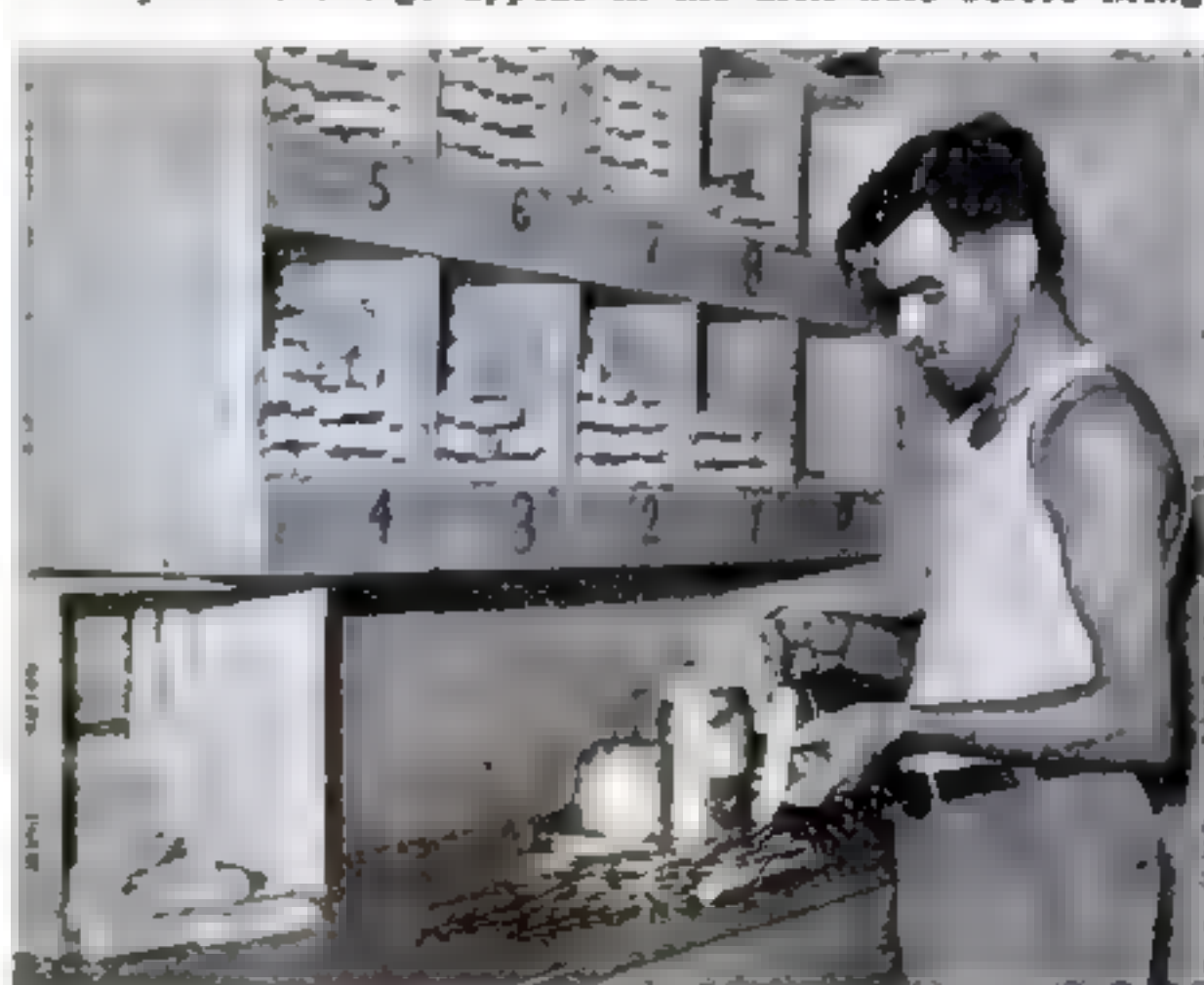
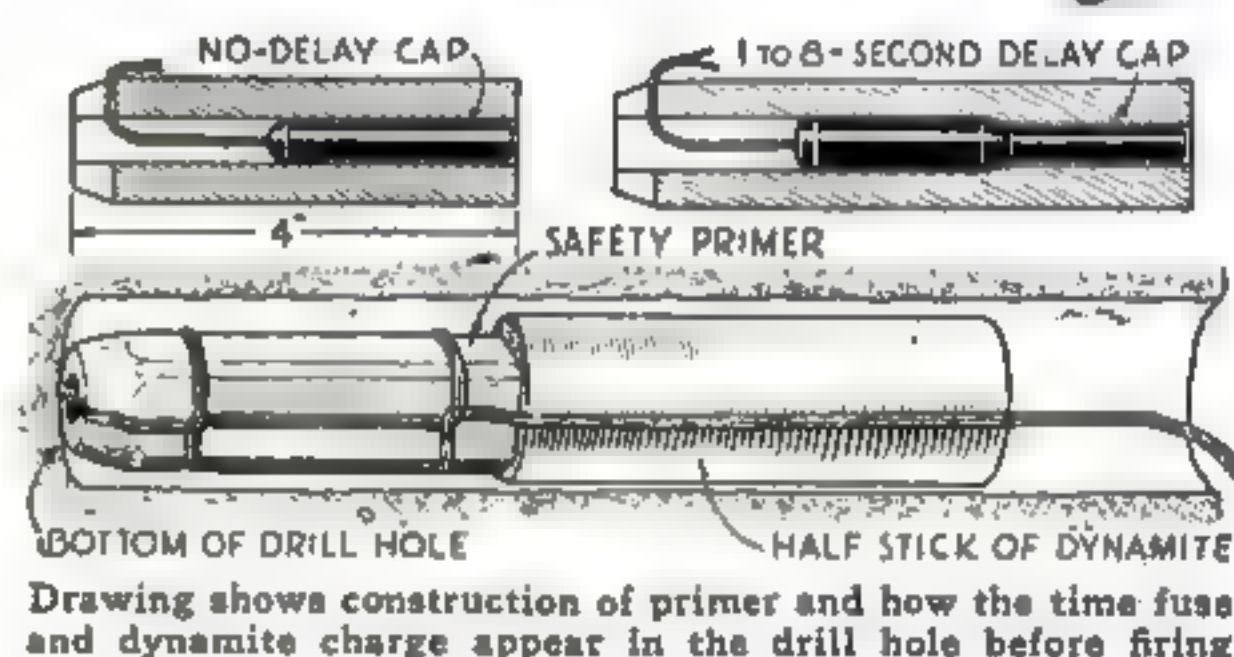
Surprising to a layman is the precision with which the excavators are able to blast a hole neatly, out of solid rock, almost to the exact shape of the finished tunnel. Suppose you wanted to snip a hole in a piece of paper, to conform accurately to an outline drawn in pencil. To avoid mutilating the edge, you would poke your scissors through the paper near the center and then bring the cut out to the penciled design. Similarly, the tunnel workers arrange their blasting charges so that the first blows a hole in the center of the tunnel face. Successive explosions, in rapid sequence, knock out surrounding rock until the rough outline of the tunnel shape, as it will be when finished, appears.

To do this, thirty-seven or more holes drilled in the tunnel face are first "mined" with explosives wired in separate sets. Only the central charge goes off instantaneously when the shift boss closes the electric firing switch, 2,500 feet away. Surrounding charges are fitted with "delay primers," wooden sticks filled with carefully weighed fuse trains of powder, and explode from one to eight seconds after the initial blast. A listener hears a "whack, whack, whack" like rapid rifle fire as the eight "delays" detonate at one-second intervals, in prearranged order, as shown in the accompanying diagram.

Huge "jumbos," double-deck carriages on railway wheels, speed the drilling for a blast. Five miners man the air drills mounted on each. When they have done their work and a round is to be fired, the men board a waiting tunnel train and are carried well to the rear. Before the blast can be exploded, an electric cable must be stretched across the tunnel between terminals on opposite sides, serving as a safety barrier. The ventilating fans that supply fresh air to the tunnel are reversed, and suck powder fumes away for fifteen minutes after the explosion before the crew returns to its work.

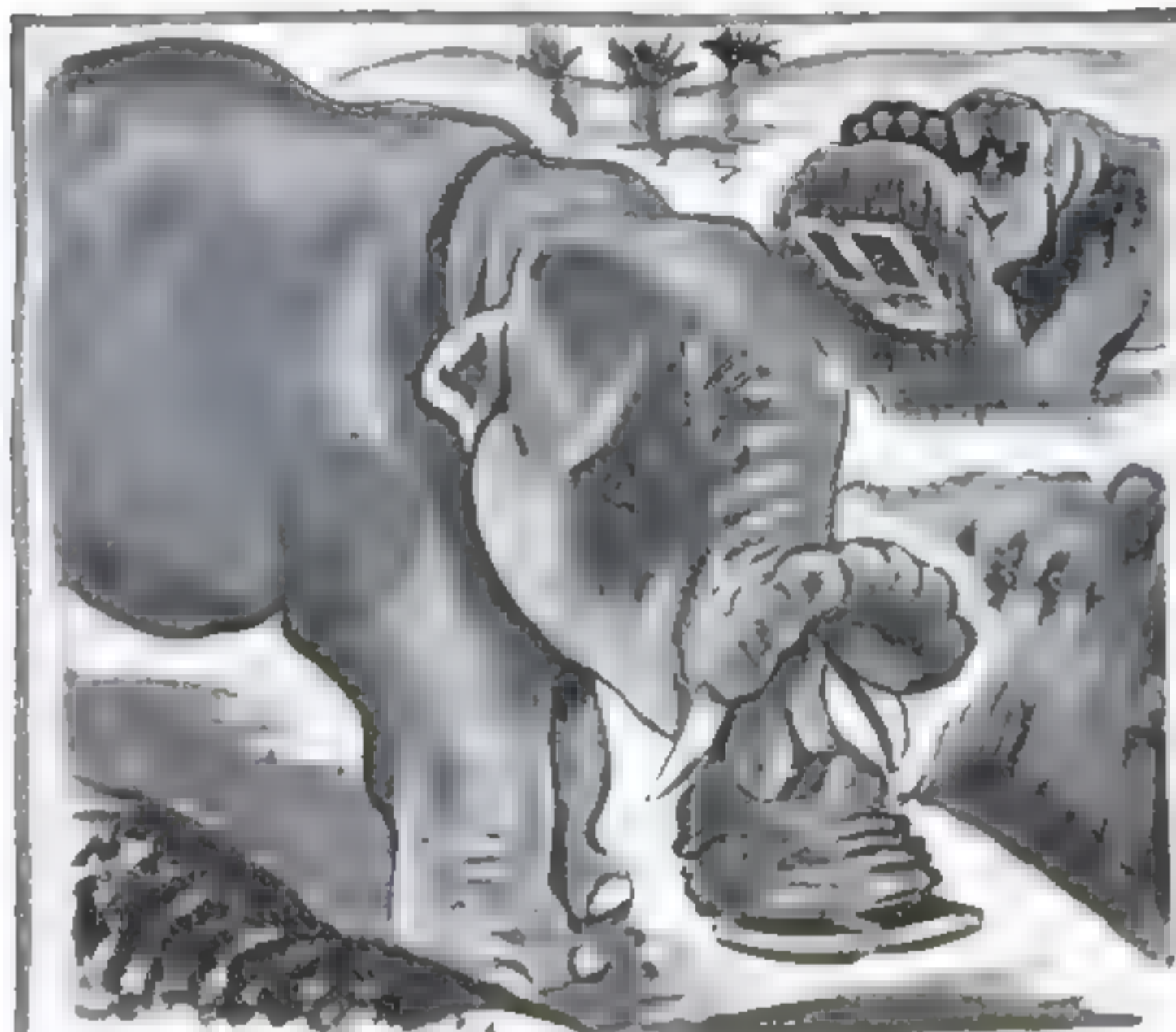
For each five-foot round, more than 135

pounds of powder are used, while a twelve-foot round requires three times as much. When the giant network of tunnels is completed in 1940, 111 expert powder crews will have drilled some 3,000,000 blasting holes and exploded more than 10,000 tons of water-resistant gelatin dynamite.



Delay fuses of various lengths being set in safety primers. Primers are stored in shelves according to their "time delay"

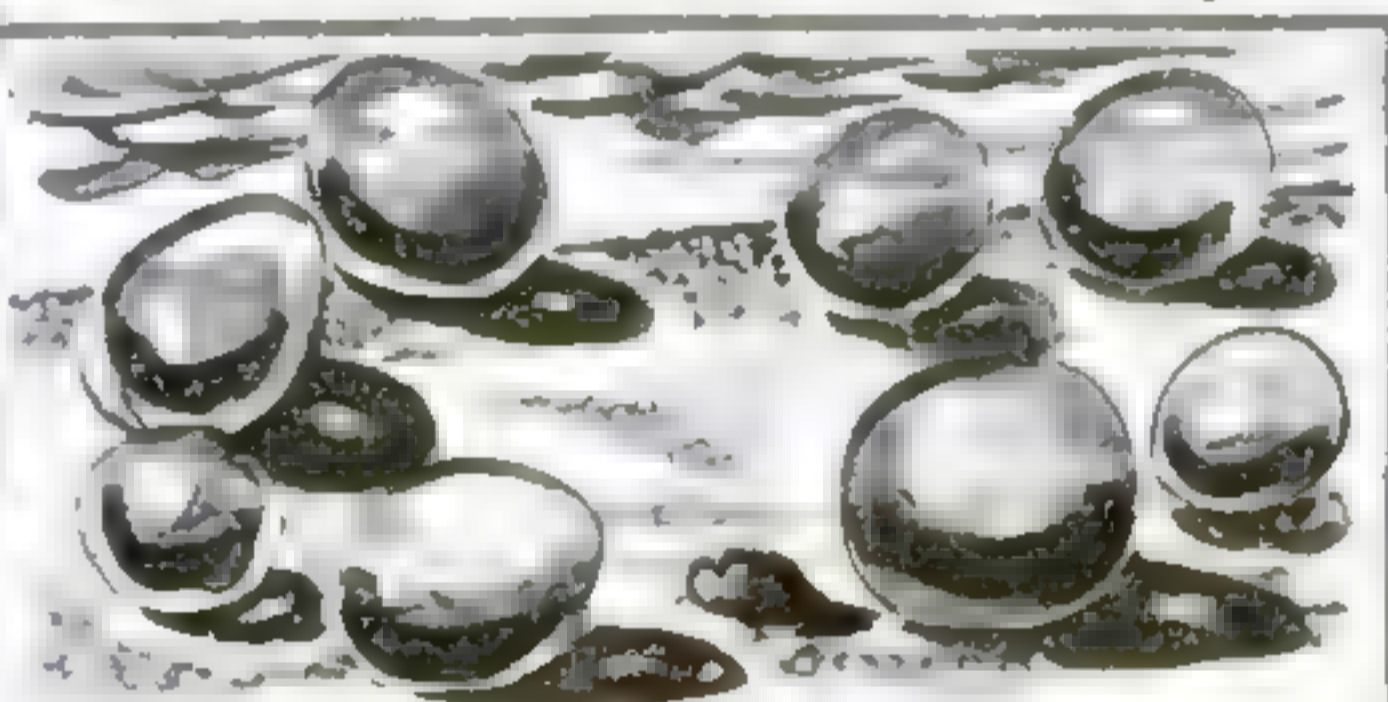
# Un-Natural History By GUS MAGER



NATURE INVENTED THE DREDGE LONG BEFORE MAN APPEARED ON THE EARTH / THE SHOVEL-TUSKED MASTODON OF THE CENTRAL ASIAN PLAINS HAD JAWS MORE THAN FIVE FEET LONG, AND USED THEM TO DREDGE UP VEGETATION FROM THE WATER AND MUD OF LAKES



HAIR WORMS, OFTEN FOUND IN POOLS OF WATER, SPEND PART OF THEIR STRANGE LIVES INSIDE GRASSHOPPERS OR OTHER INSECTS. GROWING COMMONLY TO A LENGTH OF TWENTY INCHES, THEY RESEMBLE HAIRS SO CLOSELY THAT MANY PEOPLE THINK THEY REALLY ARE HAIRS TURNED INTO WORMS BY THE WATER!



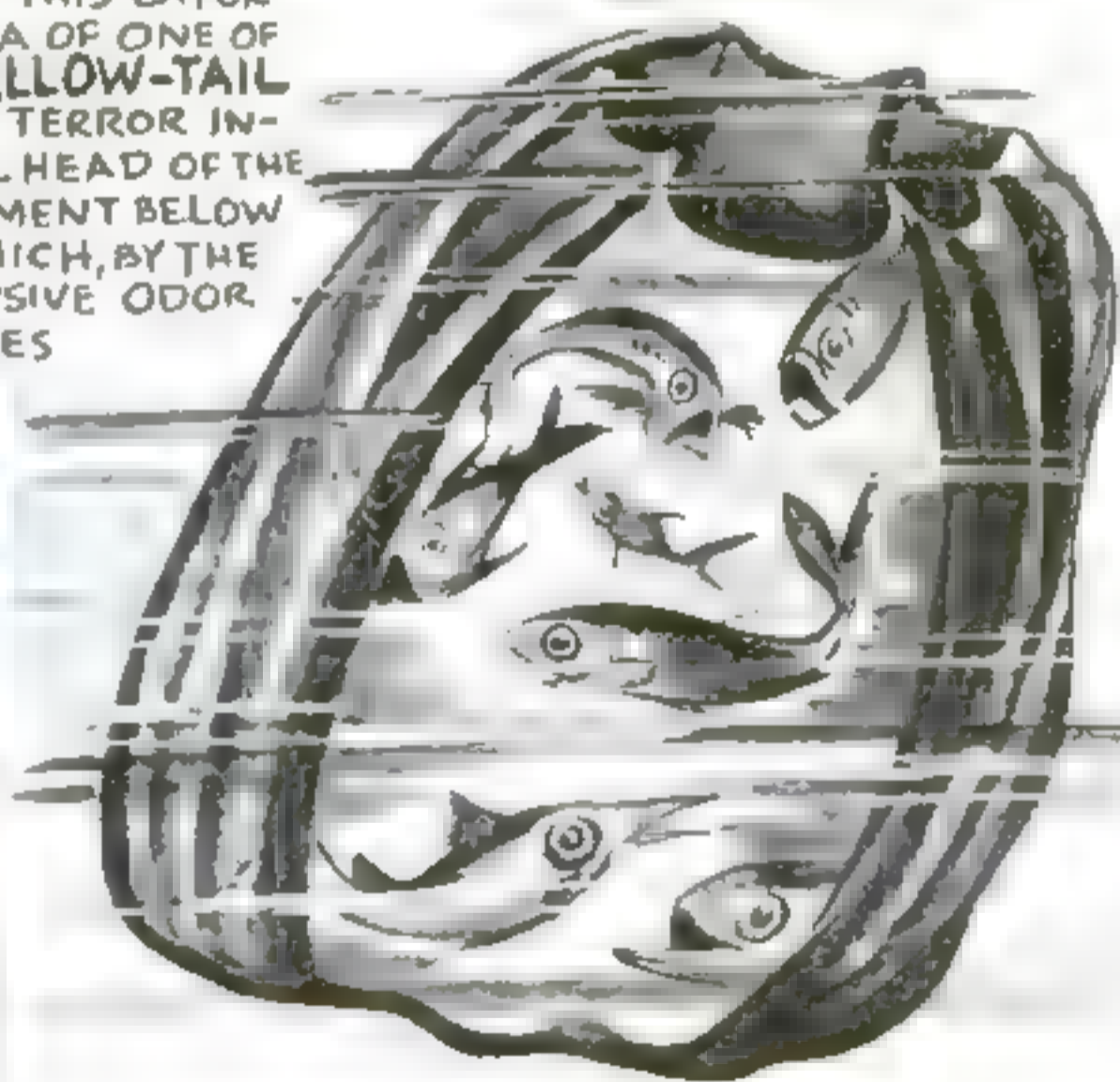
THE LARGEST SINGLE-CELLED CREATURE IN THE WORLD IS THE SEA BOTTLE, SO CALLED BECAUSE OF ITS BEAUTIFUL EMERALD COLOR. A ONE-CELLED ALGA, IT RUNS TO THE SIZE OF LARGE PEBBLES AND WASHES ASHORE ON BEACHES IN BERMUDA!



THE FALSE FACE AND PHONY EYES OF THIS CATERPILLAR, THE LARVA OF ONE OF OUR COMMON SWALLOW-TAIL BUTTERFLIES, STRIKES TERROR INTO ITS ENEMIES. THE REAL HEAD OF THE INSECT IS THE SMALL SEGMENT BELOW THE RETRACTILE HORNS - WHICH, BY THE WAY, GIVE OFF A VERY OFFENSIVE ODOR TO FURTHER DISCOMFIT FOES



DID YOU KNOW THAT THE ORIGIN OF THE GRAPEFRUIT REMAINS AN UNSOLVED MYSTERY? A CAPTAIN SHADDOCK BROUGHT SOME SEEDS TO BARBADOS, IN THE WEST INDIES, IN 1696. THEY ARE SUPPOSED TO HAVE COME FROM THE ORIENT, BUT BOTANICAL EXPLORERS HAVE NOT BEEN ABLE TO FIND A SINGLE SPECIMEN OUTSIDE OF THE WESTERN HEMISPHERE.



SMALL FISH SOMETIMES MAKE WORLD CRUISES INSIDE THE SHELL CAVITIES OF DEAD BARNACLES SUCH AS THE BALANUS OR ACORN BARNACLE. CLINGING TO THE BOTTOMS OF SHIPS, THE SHELLS PROVIDE COZY CABINS AS MUCH AS THREE INCHES DEEP BY ONE INCH IN DIAMETER. THIS ODD PASSENGER TRAFFIC PROBABLY ACCOUNTS FOR VARIETIES OF FISH FROM THE PACIFIC OCEAN OFTEN BEING FOUND IN THE ATLANTIC, AND VICE VERSA

# New Appliances



**LAYER-CAKE LAYER.** With this simple device, it is easy to stack cake layers evenly. The double flange lines up the new layer with the one below it, and holds it in position while the flat disk is slid from under it, without breaking the tenderest cake

**ABSORBS ODORS IN REFRIGERATOR.** By taking up food odors in the refrigerator or ice box, the device pictured at the right protects butter and milk from contamination. It is hung from one of the shelf grids

**MONOGRAM SOAP**  
One side of the cake of soap illustrated below is covered with a heavy coat of transparent lacquer which keeps the monogram from washing away



**NON-TIP COCKTAIL HOLDER.** No matter how you tilt this ingenious cocktail holder, the glass keeps an even keel

**COVERS FOR BRIDGE CHAIRS** Transparent covers like the one shown below protect the clothing of bridge players from perspiration stains and prevent damage to hostery. They are tinted in various colors to match upholstery



**TWO NEW AIDS FOR IRONING**  
The iron in the upper photograph contains a water reservoir which regulates the temperature and generates steam that comes out through holes to dampen the wash. Above is a thermostatic plug that shuts off an electric iron if it gets too hot

**TOP FOR BRIDGE TABLE**  
The folding plywood top shown at the right converts any bridge table into a round dinner table. Hardwood cleats hold it in place



# *for the* HOUSEHOLD



**HANDY SERVER FOR CANNED BEER.** When a can of beer is placed in this attractive server and the cover is pressed down, a punch automatically makes a hole in the can so that the liquid can be poured from the spout. The server is made of a solid, heavy-gauge nickel silver with solid brass handle and a brass lid.



**CABINET WATER HEATER.** Housed in an attractively designed, porcelain-enameled cabinet, this hot-water storage heater provides extra table space in the modern kitchen. Both heater and tank are insulated.

**WINDOW CLEANER.** With the handy cleaner shown below, the out-sides of windows can be washed easily from the inside. The cleansing surface, made of sponge rubber covered with chamois, can be removed easily for rinsing, as is seen at the right.



**FOOLS MOTHS.** A new system of moth control provides a material in which moths will choose to lay their eggs, instead of in garments; chemicals make the eggs unhatchable.



**HOME WATER COOLER.** This one-gallon vacuum container is fitted with a base and spigot. When lifted from the base, it becomes a portable jug for use on outings.



# MOSS—Two Plants *in* One

... *Strange facts shown*  
by your  
**MICROSCOPE**



Home-grown moss producing spores. When viewed under the microscope this plant reveals an odd dual personality. It has two different plant forms and reproduces itself by two entirely distinct methods

By **MORTON C. WALLING**

**T**O THE amateur microscopist, nothing revealed by his instrument is more fascinating than the unsuspected qualities possessed by objects formerly thought commonplace. Look at any minute plant or organism with the naked eye and it seems simple enough. But under the microscope, what a different story is revealed! Look, for example, at ordinary moss, and then go to the microscope to learn for yourself the story of this peculiar and widely spread member of the plant kingdom.

Moss has what psychologists would call a "dual personality." What most people regard as an ordinary plant is actually *two* plants, each completely distinct from the other. That part which we commonly call the moss plant is in actuality a separate plant, with sometimes a second plant perched on its head!

Under the all-revealing eye of the microscope, we see the evidence of one of the ingenious ways nature has devised to assure propagation of plant life, and in the process we come upon one of the most fascinating biographies in the plant world.

The common moss you see in fields, on rocks, and even along city curbstones, is of world-wide distribution. It is particularly abundant in temperate and arctic regions, where it grows in places that will support no other life, unless it

be the lichen. In addition to the common moss, with which you are familiar in a general way, there is a large group of sphagnum or bog mosses, found wherever there is marshy ground. These mosses do not contain much green coloring matter, and therefore are somewhat dead in appearance. They form dense mats which gradually sink to the bottom of the bogs and eventually may be converted into peat. Another close relative of the true moss is the liverwort, found on old logs and tree trunks.

But the kind of moss we are going to examine with the microscope is the common, everyday variety. You can collect some of it in almost any field or garden. A pocketknife and a jar or dish are all the equipment you need. After you have found a patch, cut a few sections out of it, making sure that you go an inch or so beneath the apparent surface of the ground. Be sure to obtain some plants that have long, slender stalks extending upward for perhaps a half inch, and ending in small, oval pods—the specimens which will interest us.

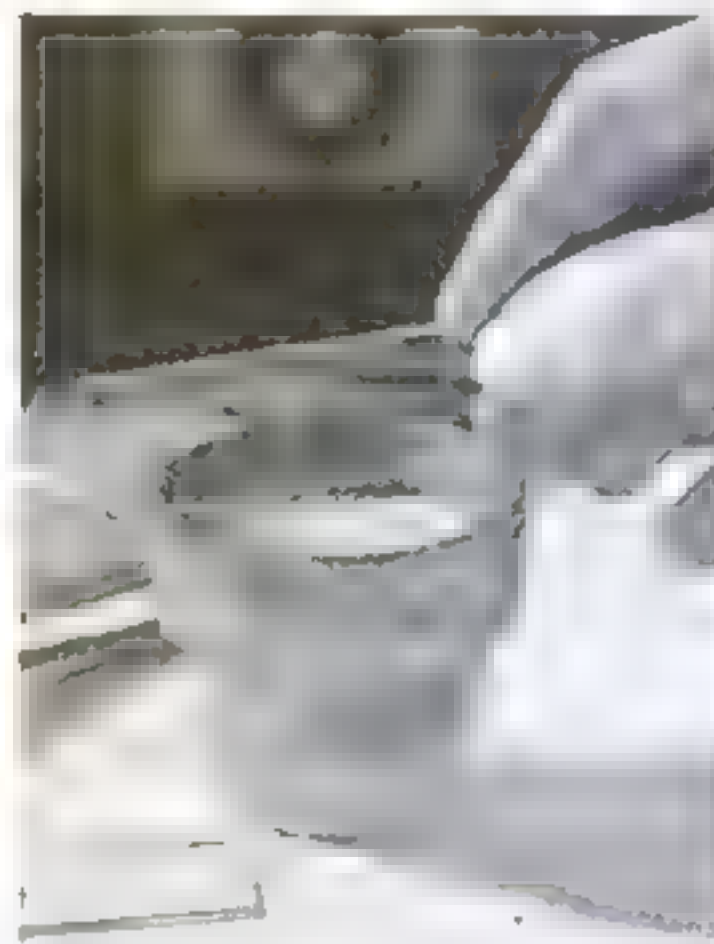
When you have returned to your microscope, lay out a number of clean slides and cover glasses, get a tumbler of clean water, and have within reach the usual medicine droppers, needles, and fine-pointed tweezers.

Clip off one of the slender stems bearing a dark-brown, podlike body at its tip, and lay it on a clean glass slide, preferably under the lens of a dissecting microscope. If the calyptra, or loose, hoodlike cover is still over the bud, lift it off. With needles or a sharp-pointed knife, remove the tip of the pod. You will find that this comes off like a little cap. In fact, it looks very much like a cone-shaped dunce cap. At 100 diameters or so, the cells making up this

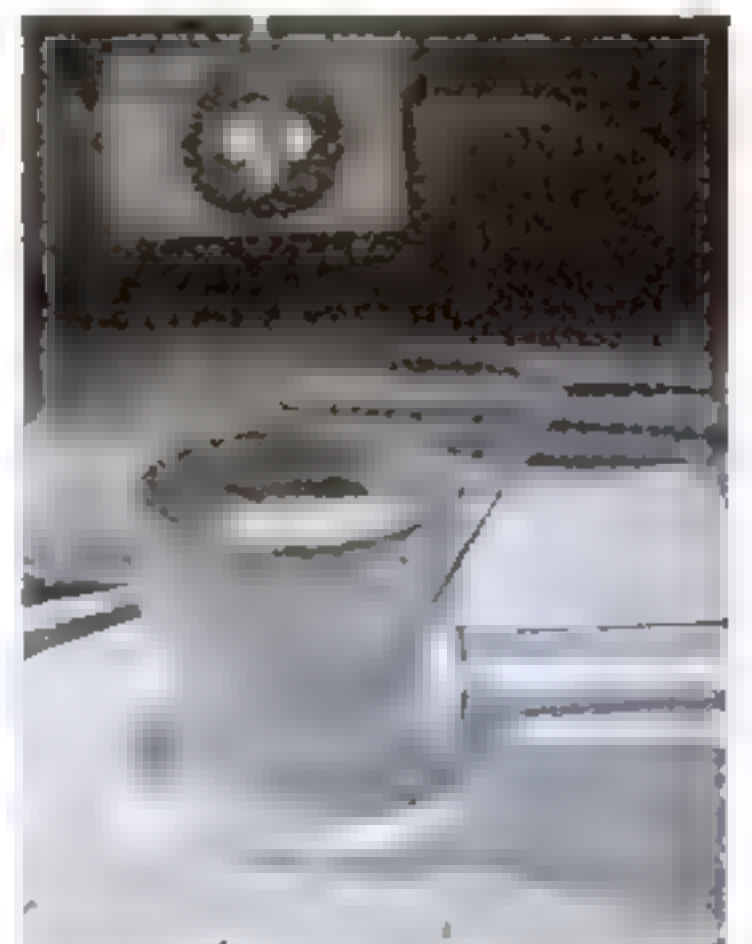
Although this seems to be only one plant it is actually two. The bulblike case, with its long, thin filament, is a distinct plant while the leafy structure from which it seems to grow is in reality a separate plant. Spores are scattered to the wind when the tip of the bulblike case falls off



Removing spores from a moss sporophyte with the aid of a dissecting microscope and needles so that they may be sown in a small pot where they will reproduce



When moss spores have been taken from the sporophyte, they are then shaken into some sterilized earth



Water, poured into a saucer under the flowerpot, is absorbed by the dirt, providing plenty of moisture



Spores emerging from a capsule of moss sporophyte. The photomicrograph above clearly shows, at the right, the tiny tip of the case which resembles a dunce cap in shape

cap are visible. Note that the edge is slightly scalloped.

The podlike arrangement which bore the cap is a spore case or capsule. Look carefully at the open end you have just uncovered, and you will find that the edge of the case is equipped with a row of slender spikes or hairs. These are used for regulating the distribution of spores from the case. Sometimes they are folded down, overlapping in such a way that they seal the opening completely. Press the side of the spore case with a dissecting needle, and the hairs will straighten out, releasing a quantity of spores.

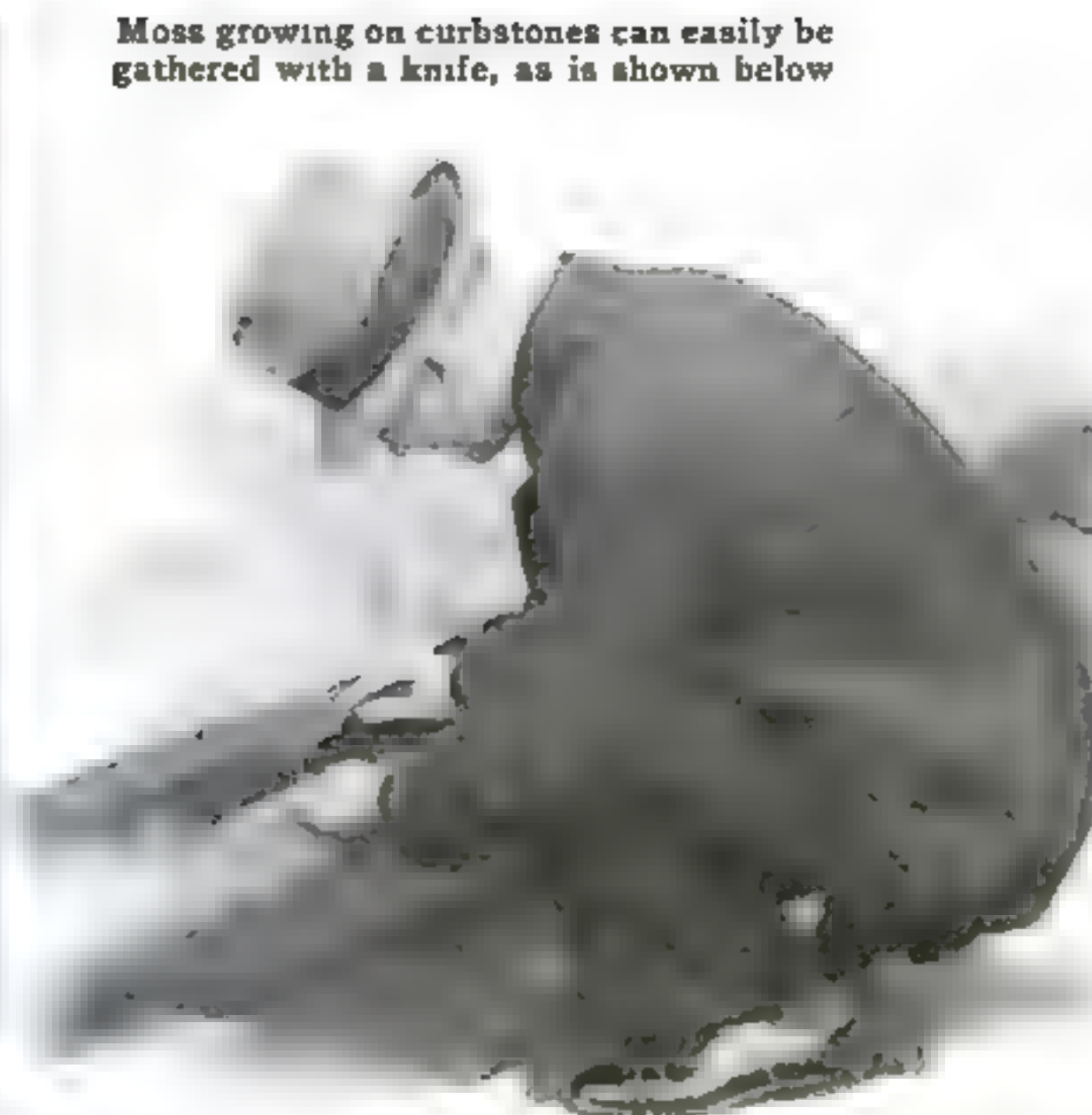
These spores are seen best at 300 or more diameters. They appear as little,

ball-like cells, not unlike the pollen of some of the higher flowering plants. When the spores are liberated from their tiny case while the moss plant is flourishing in the field, they are carried by the wind to various places. Some of them find suitable damp areas where they can germinate.

You can see how this germination goes on by planting some spores in a pan or pot of damp earth. Select those from a ripe, almost black, spore case. Watch the germination of the spores carefully with a hand lens and by looking at small samples with the microscope. You will find that they do not grow at once into the green, leafy moss plants you probably expected. Instead, they produce patches of branch-

ing filaments, which look very much like some of the green algae you have seen in ponds and lakes. The spores with which you are dealing now are of the asexual type—that is, they were not produced by sexual organs of the moss.

The algalike growth, or protonema, spreads over the earth in a thin, green layer. Ordinarily, this mass of slender, almost-invisible threads goes unnoticed by anyone except the biologist or exploring microscopist. Under the microscope the protonema strands are decidedly green in color. Mixed with them you may find dark, brownish filaments. These are the rhizoids, rootlike structures sent out by the leafy plants (*Continued on page 97*)

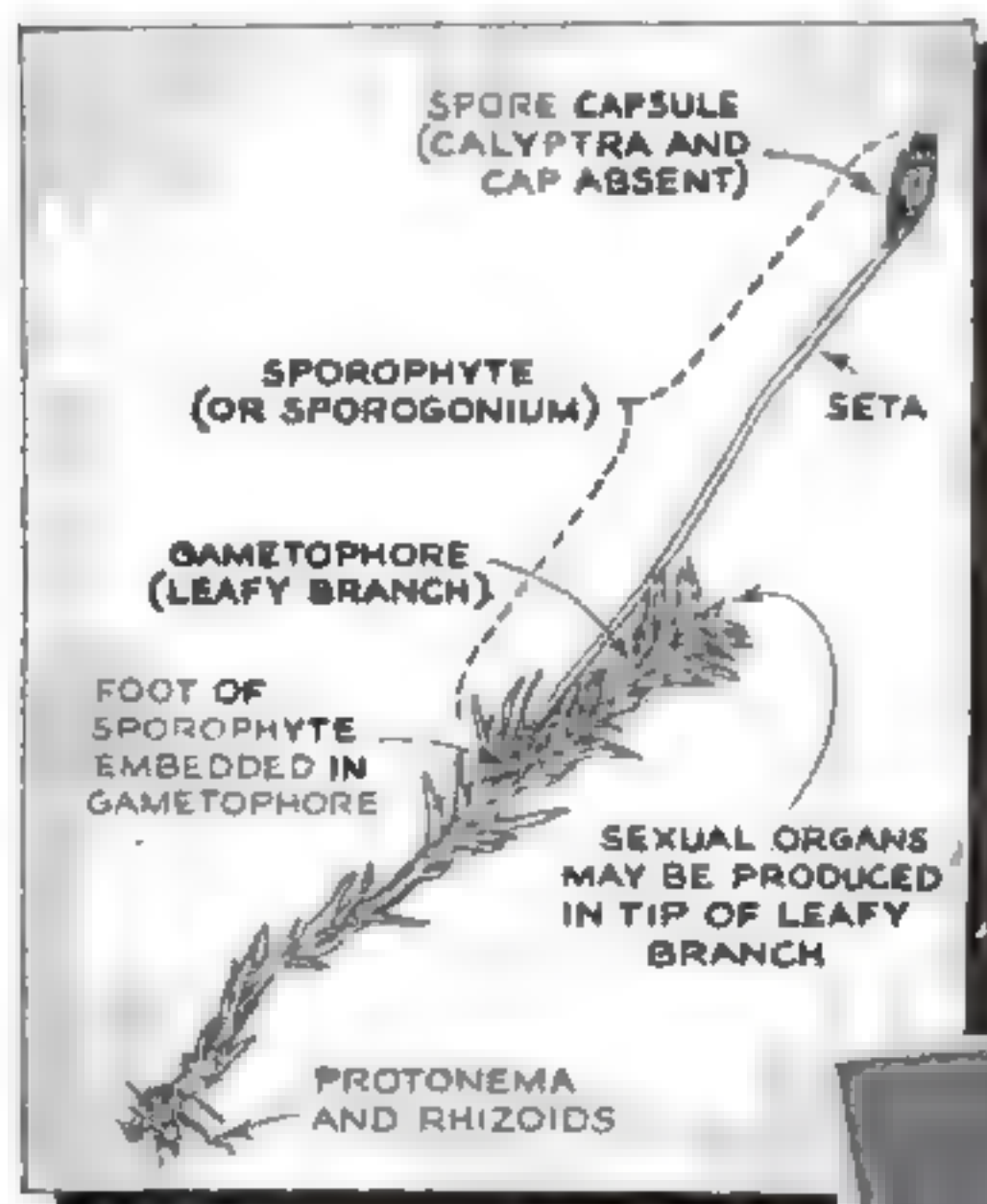


Moss growing on curbstones can easily be gathered with a knife, as is shown below

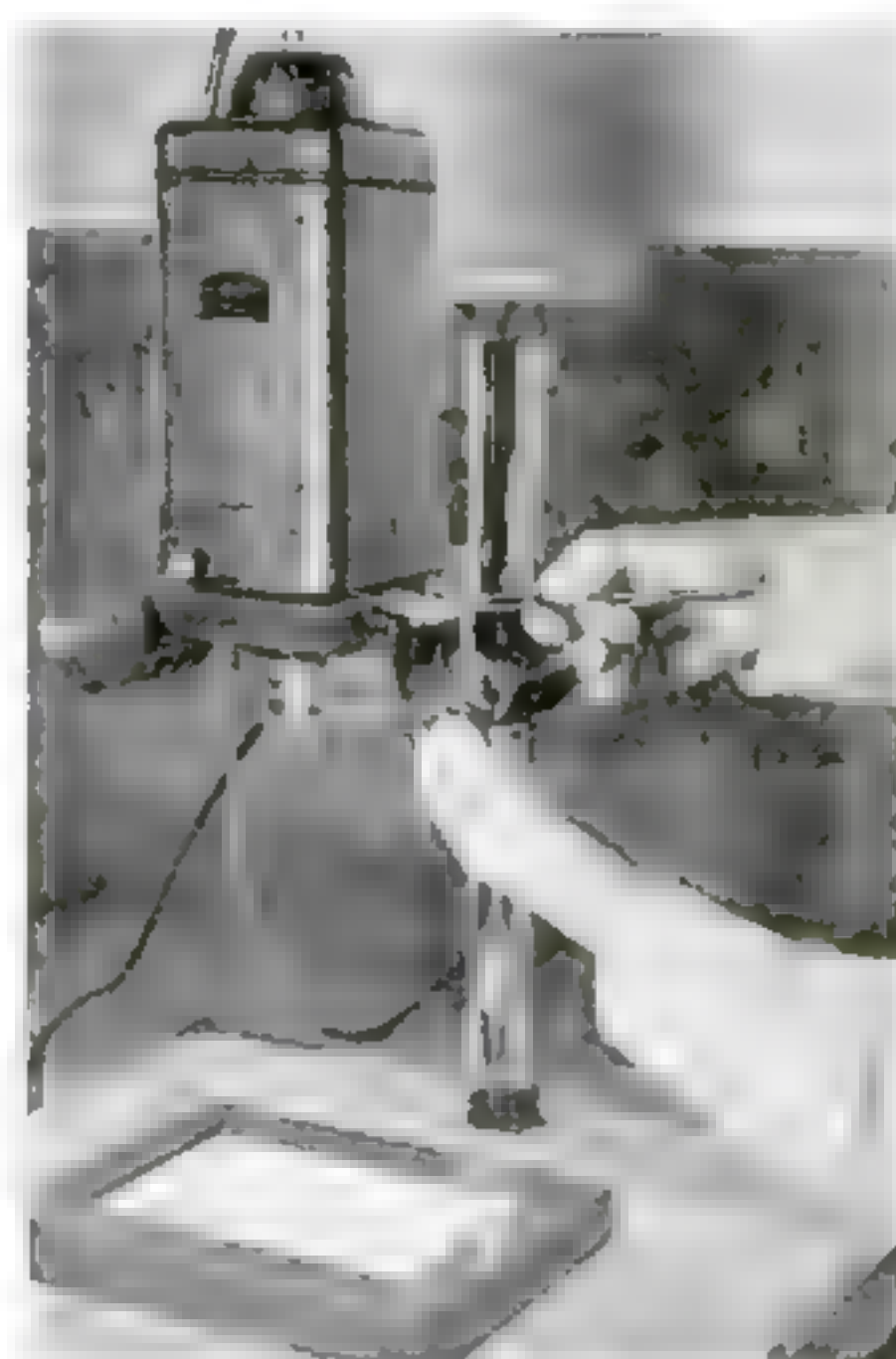
## Enlarger Aids in Photographing Large Microscope Subjects

BY USING a photographic enlarger, a clear, enlarged picture may be obtained of large objects such as a complete, leafy moss plant with its sporophyte. Mount the specimen in water under a cover glass and place the slide in the negative carrier

of the enlarger. Focus the image of the specimen on the easel and place either a sheet of bromide enlarging paper or a sensitized film on the easel and make the exposure. The outline on the paper negative can be traced with waterproof India ink and the photographic image bleached out with a solution made of tincture of iodine in from two to ten parts of water, after which the paper is immersed in the hypo fixing bath. Positive prints may be made by using either bromide or chloride paper. Simply put the sheet in a printing frame against another piece of sensitized paper, with the coated surfaces touching, and print it in the usual way.



A sketch of a moss branch and sporophyte made by photographing the plant on bromide paper. The image was outlined with waterproof ink, as at the right, and then the print was bleached



A photographic enlarger in use for making a photomicrograph of a spore-bearing moss plant. The glass slide on which the specimen is mounted is placed in the negative carrier and focused like a negative. Sensitized bromide paper, film, or plate, can be used

# CHEMICALS PRESERVE SPECIMENS IN

# PICKLE-

The author at work preparing fish for preservation by the process he describes

*"Liquid Taxidermy" Offers You  
A Means of Collecting Reptiles,  
Fish, Small Animals, and Plants*

By  
**PAUL GRISWOLD HOWES**

to our needs is formaldehyde, a relatively inexpensive and easily used fluid that is sold at most drug stores.

All that you need to do to preserve a small animal indefinitely is to drop it into a five-percent solution of formaldehyde. For larger specimens, a ten-percent solution of the fluid should first be injected with a syringe into the body cavity in several places. If you have no syringe, a few slits can be cut with a sharp knife or razor blade to admit the liquid.

One of the accompanying photographs shows a pair of twin deer preserved by this method and mounted in a large glass jar. These deer were about to be born, when the mother doe was killed by a train. No taxidermist was available, yet the specimens were considered too valuable to be thrown away. They were simply laid out in the desired attitudes until they became stiff, and then tied securely to a sheet of heavy glass cut to fit the preserving jar. Tying was done with waxed cords run through the flesh of their backs, knotted about their feet, and securely fastened at the edge of the glass plate.

The body cavities were then slit carefully in one or two places, and the cavities filled with strong formaldehyde. After this was done, the entire glass plate bearing the two deer was placed in the jar containing the five-percent formaldehyde solution. In a month, the solution was poured off and replaced with fresh, clear liquid of the same strength, and in this manner the twins have been preserved for the past twelve years.

For all small specimens, clear, straight-sided, screw-capped jars, such as pickles and preserves come in, are ideal. The sheet of glass, cut to fit, makes a mounting table, and a long needle, a pair of scissors, and waxed threads of various weights are the only other instruments you need.

Labels can be printed on bits of white cardboard with India ink and tied on with thread, or you can mount the objects on a sheet of frosted glass and write the labels directly on the glass with a soft, black pencil. For those who wish only to keep their curios, without bothering to mount them, a jar of the proper solution is all that is necessary.

**P**RESERVING specimens of reptiles, fish, and small animals in chemical solutions offers a fascinating new collecting hobby for the amateur scientist. Such objects, along with interesting fruits, leaves, and fungous plants picked up on vacation trips or during rambles in the country, can easily be built up into a private museum.

How often, while driving or walking through the country, have you found some freakish or unfamiliar creature that you wanted to keep? Perhaps you wished to show it to your friends as a curiosity, or study it yourself at your leisure; maybe you thought it would have value for a public museum. Every year, thousands of specimens, often of great scientific value, find their way to the desks of scientists and curators in museums. However, because the finders usually have little knowledge of preserving methods, the specimens are often beyond saving when they reach their destinations.

The method of preservation to be described here, which I call "liquid taxidermy," is a simplified form of the process used by museums in preparing many of their specimens. Requiring only a few empty pickle jars and some inexpensive chemicals, it can be used successfully by a beginner and will keep anything from a small mouse to a new-born deer—except, of course, that the deer will require something larger than a pickle jar for a show case.

Alcohol, as you probably know, will preserve almost any organic matter. However, it is too expensive for our present purpose and requires special handling that is beyond the skill of the amateur. Better suited



## THIS PROCESS MAKES FISH SPECIMENS LIFELIKE

The fish is first cut open along one side, and the internal organs are removed. The cavity is then washed out with a boracic acid solution and stuffed with absorbent cotton to give it a lifelike appearance. After the edges of the incision have been sewed together with thread of a matching color, the fins are erected and set with long pins until after they have stiffened

# JAR MUSEUMS

Although formaldehyde solution will preserve almost anything it is not altogether satisfactory for use with fish, since it turns them somewhat gray or white. For a number of years, I have been experimenting with a process that will not dull the natural color of fish, and while this has not as yet been entirely perfected, the results are far better than those achieved with the formaldehyde and alcohol methods. The color of the fish, including the black pupil of the eye and the tints of the irises, is fairly well preserved so that the specimens are much more lifelike, when mounted, than the white-eyed specimens preserved in other solutions. This process works best with salt-water fish, but good results can be obtained with brightly colored fresh-water species if they are prepared when perfectly fresh.

The specimen is first cleaned and set up. That is, while being kept wet with a solution of weak boracic acid, the fish is carefully cut open along one side and the internal organs are completely removed by means of forceps and scissors. The cavity is then washed out with the same solution and the mucus washed from the scales with cotton wads which have been soaked in the boracic acid.

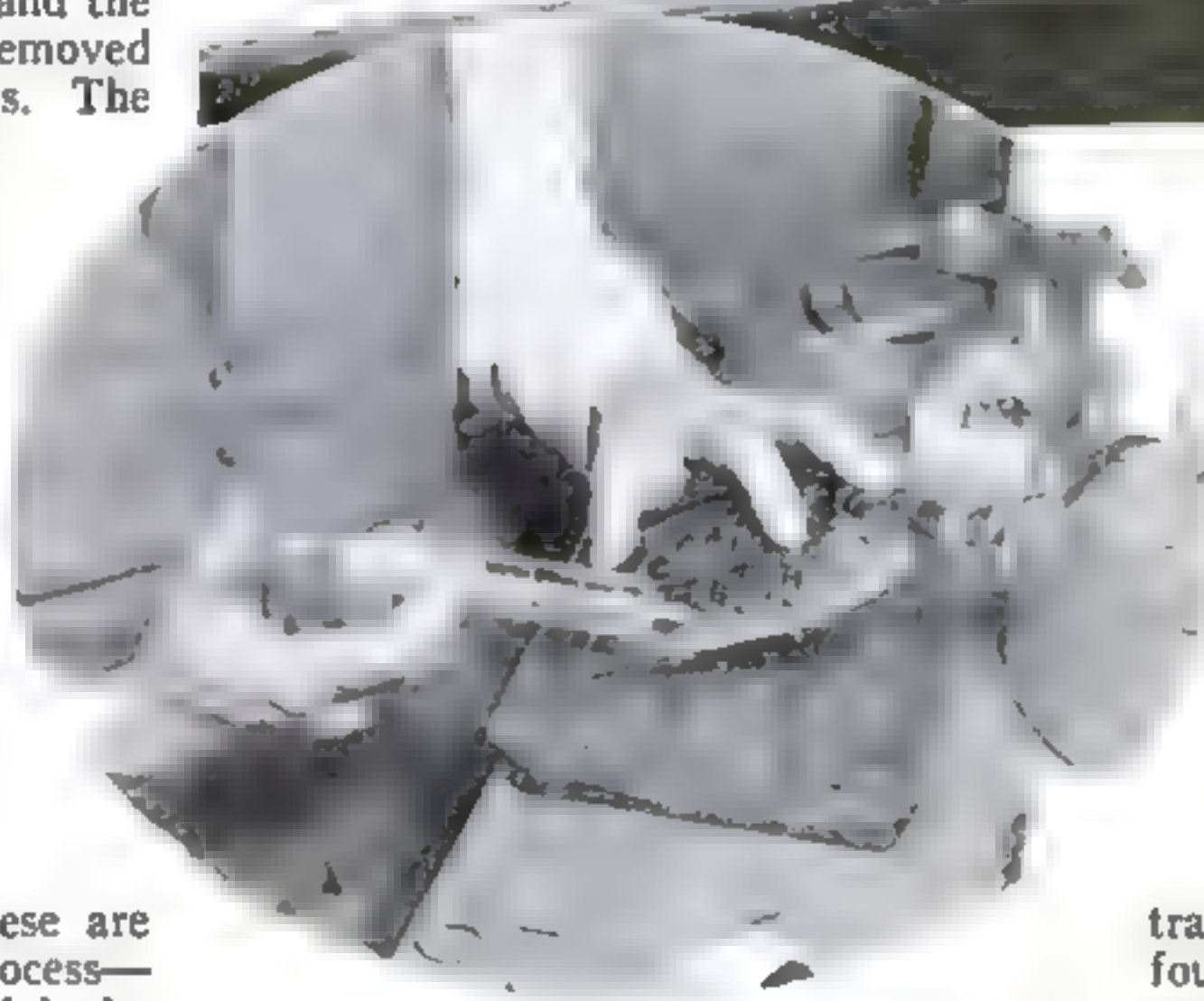
When the specimen is perfectly clean, the body cavity is stuffed with absorbent cotton so that it assumes a natural appearance. The edges of the incision are sewed together carefully with a fine needle and thread, or silk, of a suitable matching color.

The fins then are erected and set with long pins inserted in front of one of the fin rays and pushed firmly into the flesh. These are removed after the preserving process—just before the specimen is placed in its final solution and after the fins have had time to stiffen sufficiently.

Before obtaining any fish specimens for preserving, it is best to prepare the six necessary baths, as the work must be done while the specimen is fresh. The first bath consists of four parts of a fifteen-percent



The pair of twin deer in the large jar were preserved by injecting a ten-percent solution of formaldehyde and immersing them in a five-percent solution. At left, a snake gets a shot of fluid



glycerin solution and one part of a two-percent formaldehyde solution. In the second, third, and fourth baths the glycerin solution is stepped up to twenty-five, thirty-five, and fifty percent respectively, while the formaldehyde solution in each is kept at two percent. In each of these

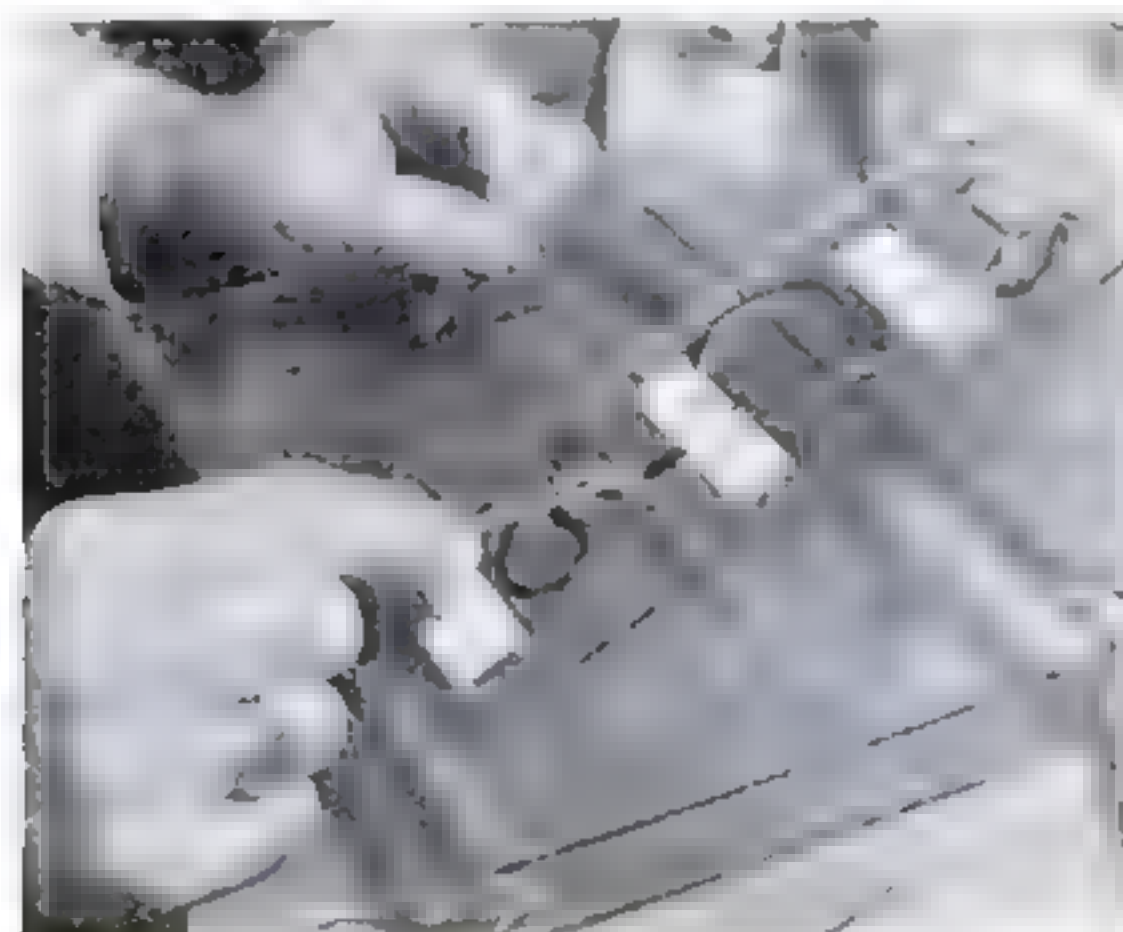
baths, the proportion is four parts of the glycerin solution to one part of the formaldehyde solution. The fifth bath is a seventy-five-percent glycerin solution without formaldehyde, and the sixth bath consists solely of pure glycerin.

When the specimen is set, washed, and stuffed with cotton, place it in the first bath for twenty-four hours, transfer it to the second bath for twenty-four hours, and so on, until the final 100-percent pure glycerin is reached.

These baths are all necessary, as the heavy glycerin must work into the tissue gradually, expelling the oils without crushing the specimen. If the fish is large, the final 100-percent solution will have to be renewed after a month, and probably two or three times thereafter. One of the features of this process is that it actually embalms the specimen. After three months, even with a large specimen, it may be removed from the solution, washed in pure water, and kept indefinitely without further care.

Fruits, leaves, and fungi also may be preserved in a simple formaldehyde solution, but as in the case of fish the colors fade out. There is a process, however, which will preserve the beautiful green color caused in leaves by a substance known as chlorophyll.

In making the solution for this process mix ninety cubic centimeters of a fifty-percent ethyl alcohol solution with five cubic centimeters of a solution (Continued on page 103)



Small reptiles being mounted in lifelike positions on a glass plate. The glass is cut to fit inside the jar in which the specimens will be immersed. Labels may be lettered in India ink on cards tied to the plate



This photograph shows how specimens are tied to the glass plates. Waxed cords are passed through the flesh of the back, passed around the plate, and tied at the edge. Specimens can also be left free in the solution

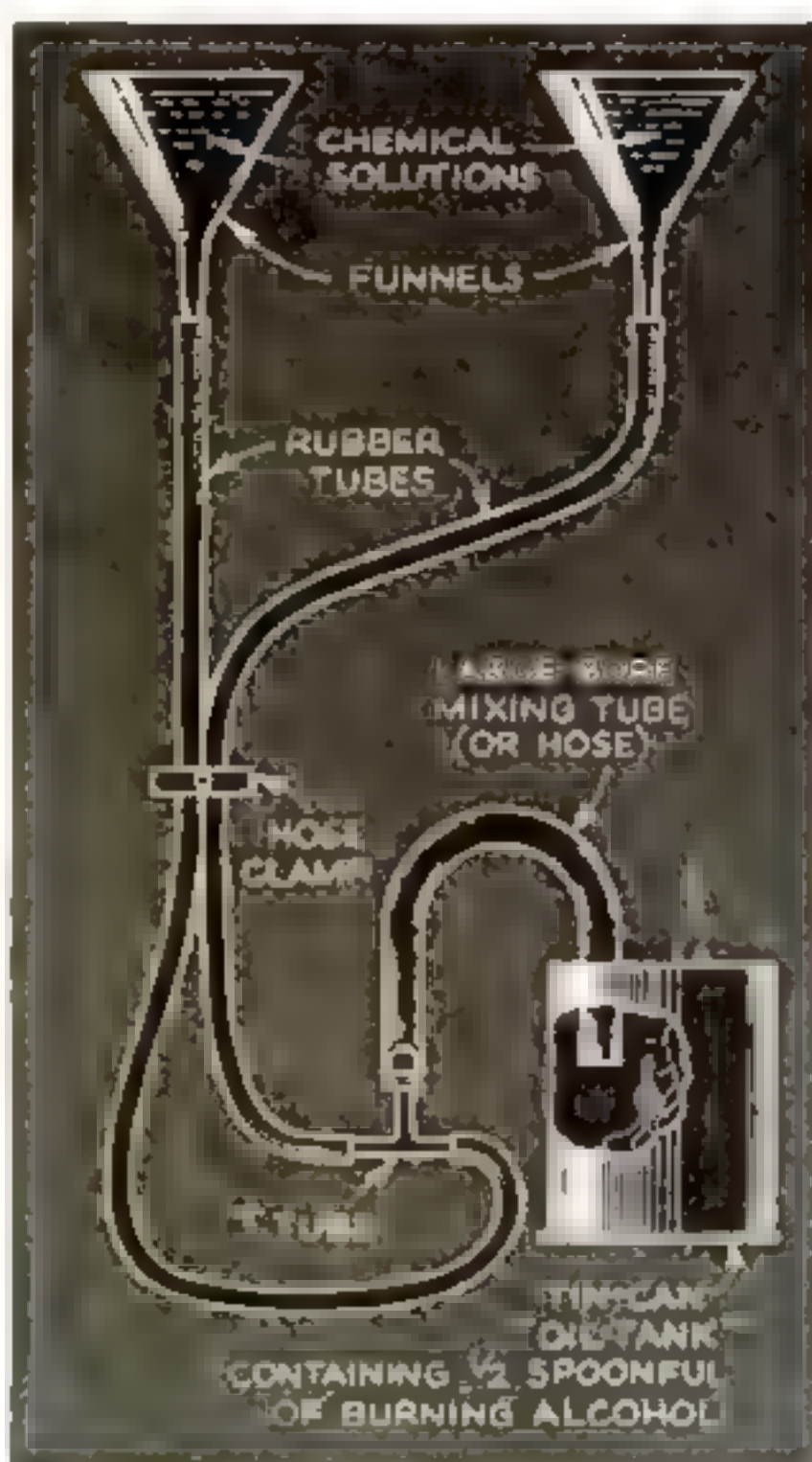
# Oddities of WATER

*Easy Experiments Demonstrate the Part That This Most Familiar of Compounds Plays in Important Chemical Reactions*

By **RAYMOND B. WAILES**



This simple experiment shows how the foam-type fire-extinguishing systems operate. Two chemical solutions meet in the T-shaped joint and form tough bubbles of carbon dioxide that smother the blaze of alcohol in the tin can



other electromagnetic experiments where coils of copper wire would ordinarily be employed. Alternating current is unsuitable for such experiments, but dry cells or radio batteries of any type may supply the electricity.

Most of the chemicals with which you are familiar readily form current-carrying ions when they dissolve in water. Some substances, however, do not. You can compare the ion-forming tendencies of different materials by breaking an electric circuit that lights a lamp, and dipping the ends of wire at the break into a vessel containing pure water. The lamp remains extinguished. When you add an ion-forming substance to the water, however, the lamp will light, just as if a wire had closed the gap.

Ion-forming chemicals include familiar inorganic compounds such as copper sulphate, sodium carbonate, magnesium sulphate, and various acids. If, instead, you add sugar, glycerin, or al-

cohol to the water, the lamp will not light. Although these substances dissolve in the water, they are incapable of forming the ions which, like microscopic ferryboats, carry the current from one wire to the other.

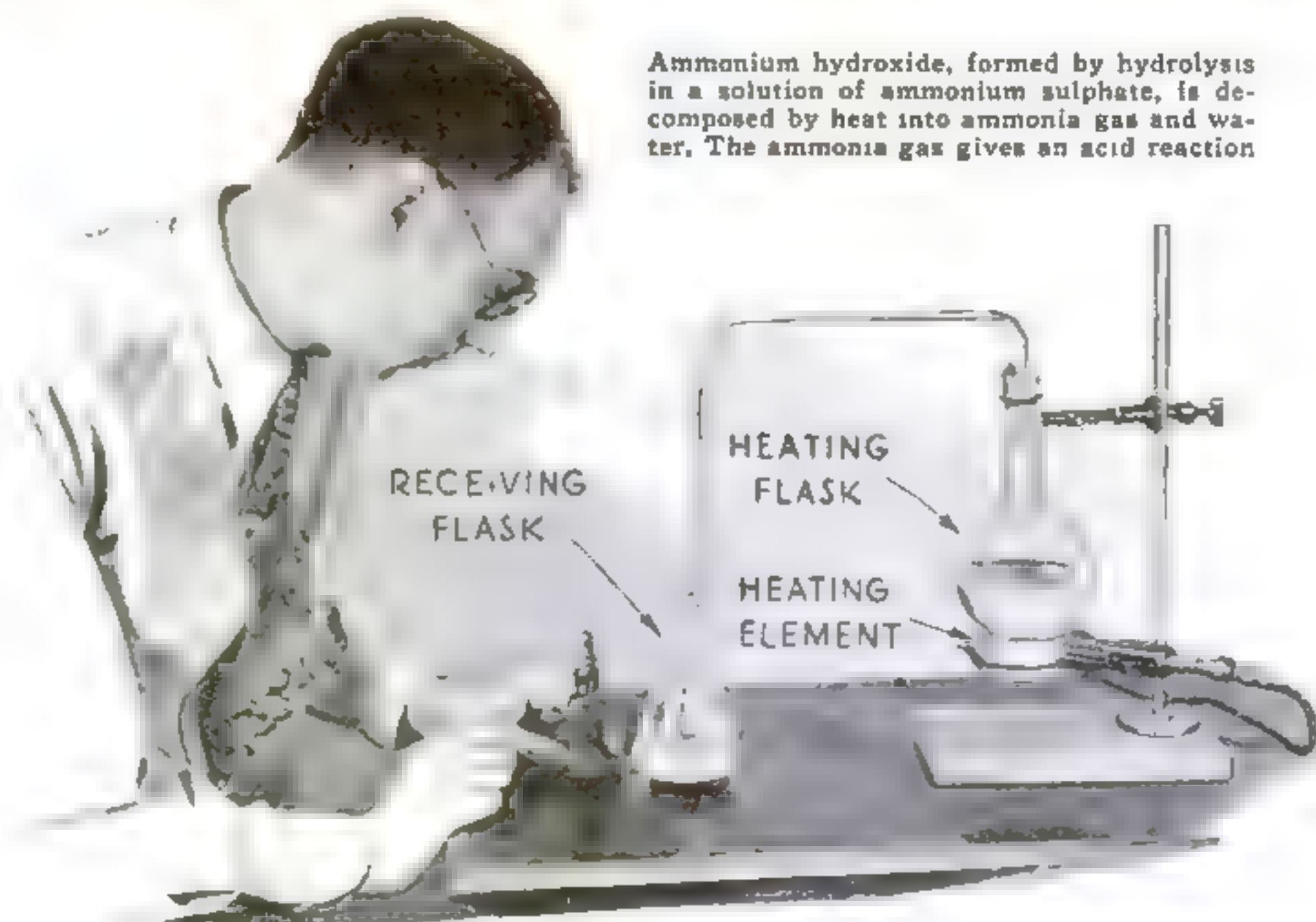
You noticed, in this experiment, that the lamp remained unlit when the wires

**I**F YOU were to pick the most useful and versatile chemical in your home laboratory, water might well be your choice. It enters actively into many reactions, serves as a solvent or vehicle for others—and ionizes acids, bases, and salts by transforming them into electrically charged particles with curious properties. All of these characteristics of water lend themselves to interesting tests.

Dissolve some salt or sulphuric acid in water, and you will have an abundant supply of ions to experiment with. Common salt, or sodium chloride, breaks up into sodium ions and chloride ions; sulphuric acid disintegrates into hydrogen ions and sulphate ions. These ions, or electrified particles, have the power of conducting a current of electricity through a liquid.

A novel way to show the resemblance between an electric wire and a water solution containing ions is to wrap a few feet of rubber tubing in a coil around a straight glass lamp chimney or a cardboard cylinder. Fill the tubing with a strong solution of salt or a weak solution of sulphuric acid in water, taking care that all the air bubbles are driven out. Place a small compass within the cylinder, and set it with its axis in an east-west direction, or crosswise to the needle of the compass. Hook together three or four dry cells and dip wires from the terminals into the

liquid at the ends of the rubber tubing. You will see the compass needle swing at right angles to its former position. The liquid-filled coil of tubing acts as an electromagnet, exactly as would a helix, or spiral, of electric wire. You can use the same coil of salty or acidulated water in



Ammonium hydroxide, formed by hydrolysis in a solution of ammonium sulphate, is decomposed by heat into ammonia gas and water. The ammonia gas gives an acid reaction

# Shown *in* Home Laboratory

were dipped in pure water. It would be reasonable to conclude that no ions were present, but this is not strictly true. Water itself, to a slight extent, breaks up into ions of its own. They are too few to carry enough current to light a lamp, but they play an extremely important role in the chemical behavior of water, as we shall shortly see.

A beginner in chemistry might expect that solutions of salts like copper chloride, aluminum sulphate, zinc chloride, and ammonium sulphate would prove to be neutral—that is, neither acid nor alkaline. By applying litmus paper to a solution of any one of these, however, you can easily demonstrate that it is actually acidic. The explanation is to be found in the interaction of ions of the chemical with ions of the water.

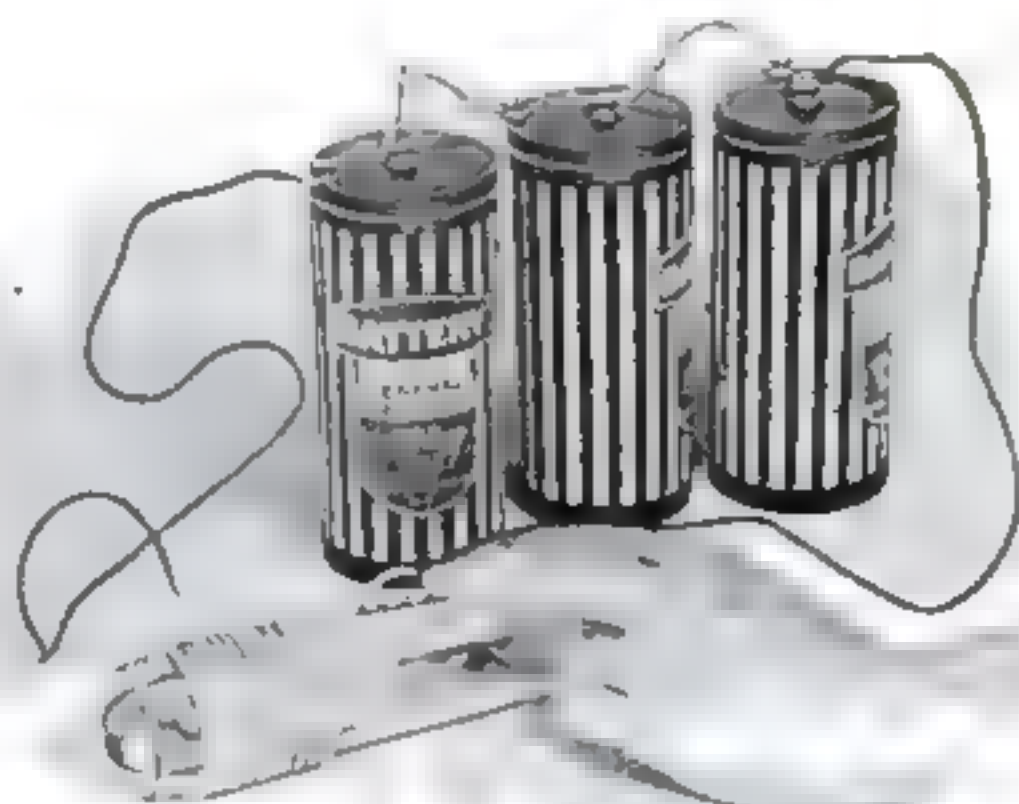
Take, for example, ammonium sulphate, which is commonly used as a fertilizer. Its value for this purpose is twofold, since it serves also as a weed killer. This is because it leaves the soil in an acid condition, unfavorable to the growth of plants of the type we know as weeds. Let us see, now, what happens when ammonium sulphate comes in contact with water—in other words, with the moisture of the soil. First, it breaks up into ammonium ions and sulphate ions. The water also is split, to some extent, into hydrogen ions and hydroxide ions. These two groups tend to exchange partners, and the ions recombine, forming ammonium hydroxide and sulphuric acid. As you

know, the first is a weak alkali and the second is a strong acid. Hence, the solution is not neutral, but is more acid than alkaline, and the net result is to acidify the soil.

This interaction of ammonium sulphate and water, a type of reaction known as "hydrolysis," is easy to demonstrate in the home laboratory. Heat a solution of ammonium sulphate in a flask fitted with a one-hole stopper and a length of glass tubing, which leads to a second flask containing water and a few drops of phenolphthalein solution. The tubing should end just above the surface of the latter liquid.

Heating the flask aids the reaction between the salt and the water, and also enables you to check up on the products that are formed. One of them, ammonium hydroxide, is decomposed by the heat into ammonia gas and water. This ammonia gas escapes through the glass tubing and is readily detected by the fact that the water containing phenolphthalein turns red. The sulphuric acid remains in the first flask.

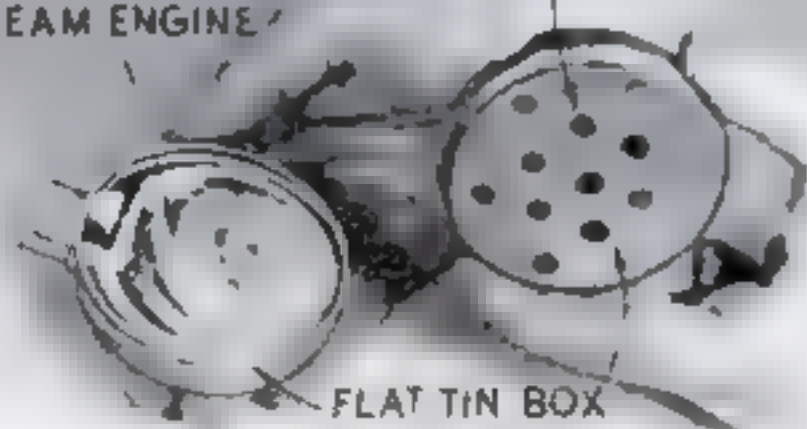
Dissolving one or two grams of phenolphthalein powder in 100 cubic centimeters (or, roughly, three fluid ounces) of alcohol makes a test solution of suitable strength for detecting alkalis in this experiment and others. In an acid solution it is colorless, while alkalis turn it pink or red. A medicine dropper, thrust through a hole bored in a cork, makes a handy dispenser for use with a small bottle of the liquid; the cork is simply lifted out and the dropper used without detaching it from the cork. The simple set-up used in the ammonium sulphate experiment, by the way, can also be employed *(Continued on page 111)*



An electric current passing through the water solution in the tube, as through a coil of wire, creates a magnetic field which is indicated by the compass in the cylinder



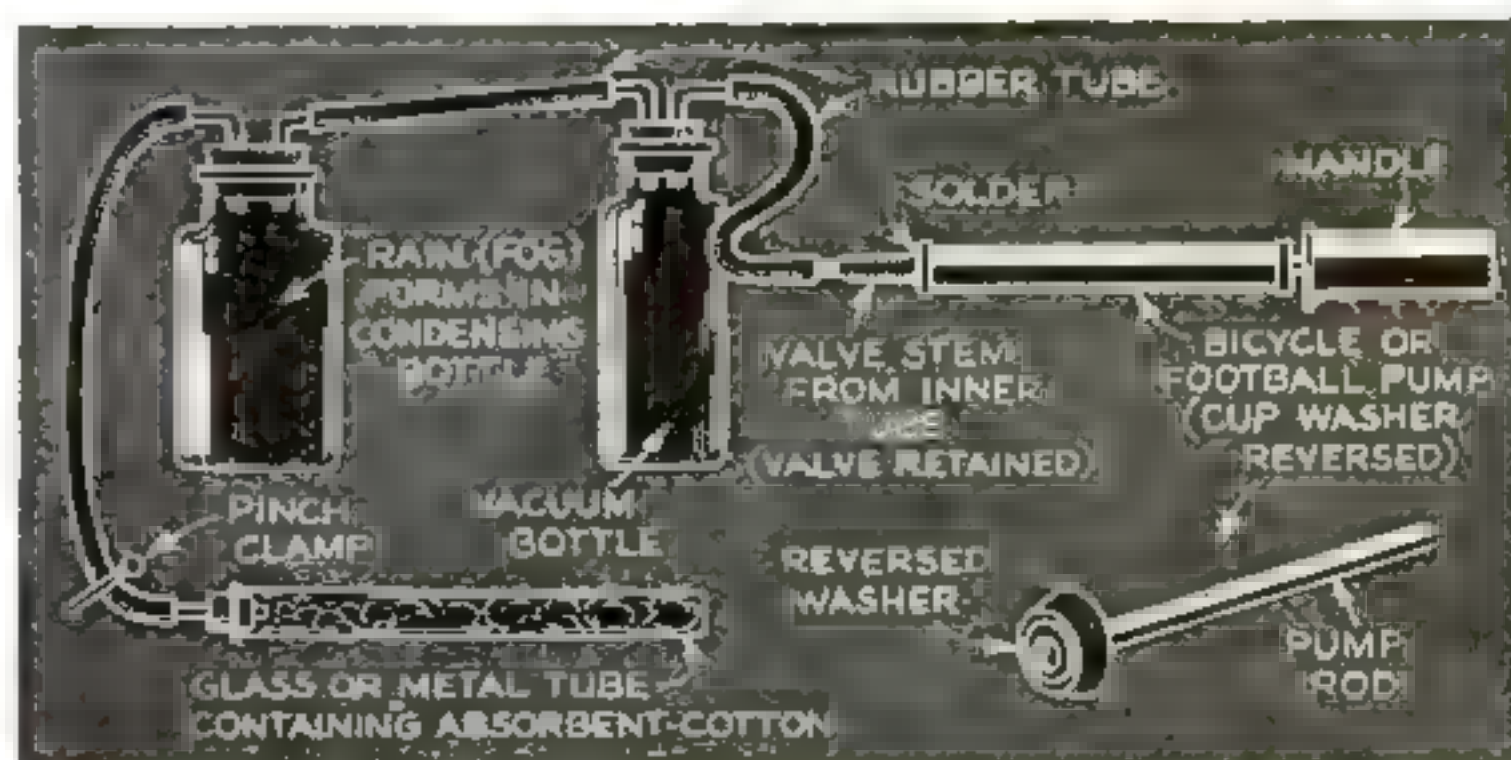
HEATING ELEMENT FROM TOY STEAM ENGINE



FLAT TIN BOX

## Toy Steam-Engine Part Makes Handy Electric Heater

A useful electric heater for home chemical experiments can be made from the heating element of a toy steam engine or turbine, purchasable almost anywhere for a quarter. Remove the element and make a case for it from an empty tin, of the type used for ointments and salves. Lye water will remove the enameling from the tin, and the holes shown in the illustration may be punched or drilled. A rat-tail file will remove rough edges. The little heater operates directly on 110-volt house current, and will prove a handy accessory for any amateur laboratory. The photograph above shows how the heater is assembled, and it is seen in use in one of the illustrations on the opposite page, where it is being employed for heating a flask.



Photograph and drawing show how a homemade vacuum pump is used to demonstrate the curious part that dust particles play in the formation of fog

# Home Tests of Scientific Laws



## *Light Beams Show How Lenses Work*

OPTICAL experiments to illustrate the action of mirrors and lenses are made easy by the use of a sheet of cardboard in which narrow slits have been cut. Light passing through the slits is arranged in parallel beams that clearly show the direction followed by the light as it is reflected or refracted. In the illustration at the left, a curved mirror is bringing the beams to a focus.



## *Gyroscopic Action Shown By Bicycle Wheel*

A BICYCLE WHEEL and a piano stool are all that you need for a striking demonstration of a gyroscope's action. Weight the wheel by wrapping heavy wire around the rim and fasten handles to the axle. Sit on the stool and spin the wheel at arm's length. Tilt the wheel and you will start to turn on the stool; tilt it the other way and you will turn in the opposite direction.

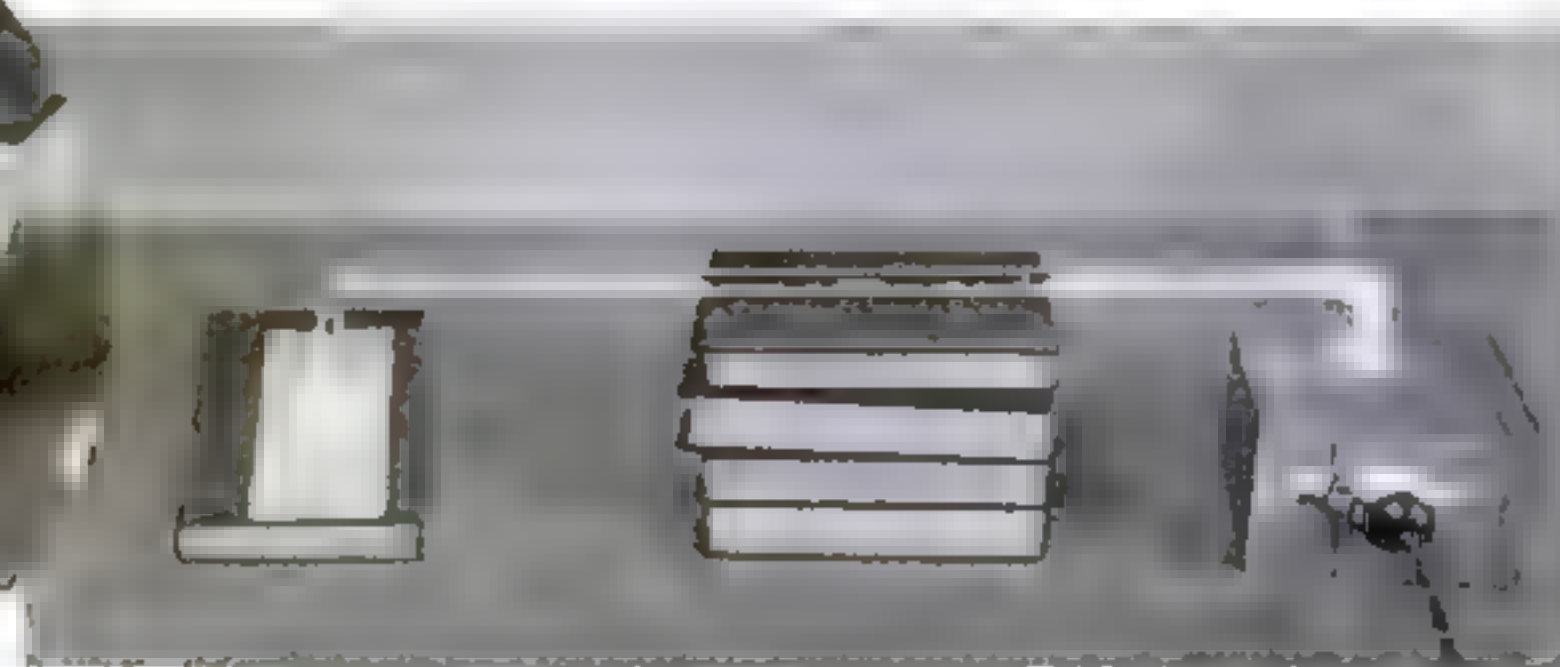
## *Pendulums Exchange Energy*

HANG two pendulums of equal length from a U-shaped wire suspended from screw hooks, as shown, and start one swinging. After a few swings, the second pendulum will take up the motion and the first will stop. This exchange of motion, with pendulums moving alternately, will continue until all energy is used.



## *Light "Flows" Through Glass Rod*

THAT light will travel through a glass rod much the same as water flows through a pipe is easily proved by placing one end of a glass towel rod over a shielded electric bulb, as shown. Since the light within the rod strikes the surface at a small angle it is reflected back along the rod instead of escaping, so that very little light is lost.



## *Invisible Rays Burn Paper*

You can burn a hole in black paper with invisible heat rays by using a saturated solution of iodine in carbon tetrachloride and a magnifying lens. Pour the solution into a small, flat bottle and direct the sun's rays on it with the lens. Infra-red rays will pass through the solution and burn black paper which absorbs the heat readily.

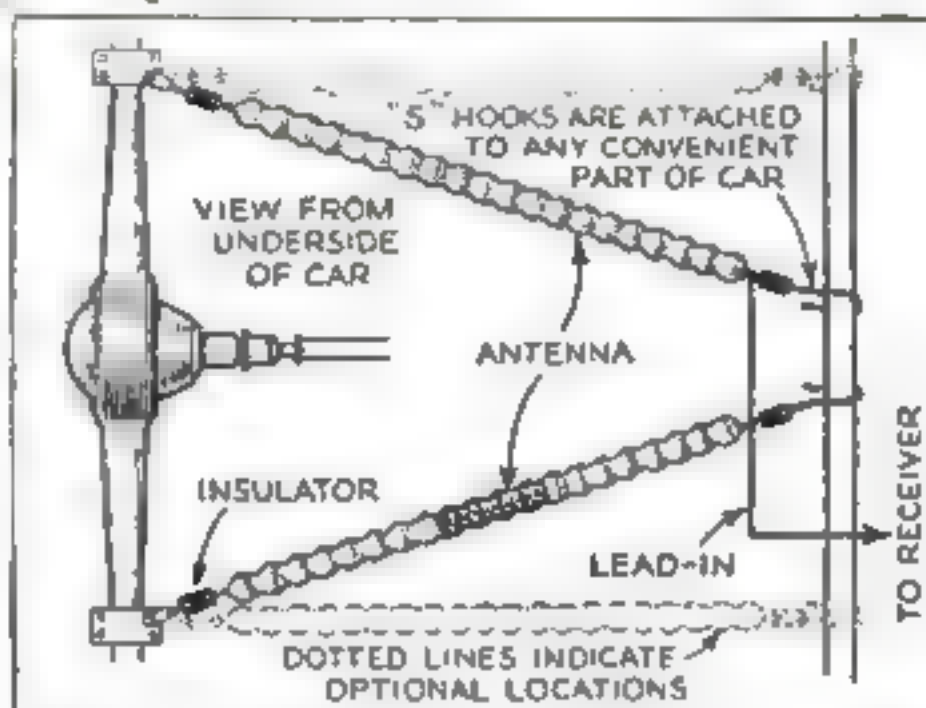


## *Heavy Vapor Supports Floating Bubbles*

SOAP BUBBLES, floating mysteriously in a bowl, illustrate the high density of carbon tetrachloride vapor, which is several times as heavy as air. Pour a teaspoonful of carbon tetrachloride (a common type of cleaning fluid) into a deep bowl, and wait a minute or two for the vapor to accumulate. Then blow a soap bubble and drop it gently into the bowl. Instead of dropping to the bottom, it will float on the invisible vapor, bobbing up and down like a cork on water. A very thin, light bubble will even float partly above the rim of the bowl.



**M**ADE in the form of two coiled springs, the latest in automobile radio antennas can be installed easily under the chassis of any car. The improved pick-up claimed for this antenna is said to result from the great increase in size of the antenna surface. More than twenty feet of wire are contained in each spring, giving a comparatively high capacity to ground. Black oilcloth covers protect the wires from dirt and mud, while the springlike construction of the antenna itself eliminates the possibility of dangling wires.



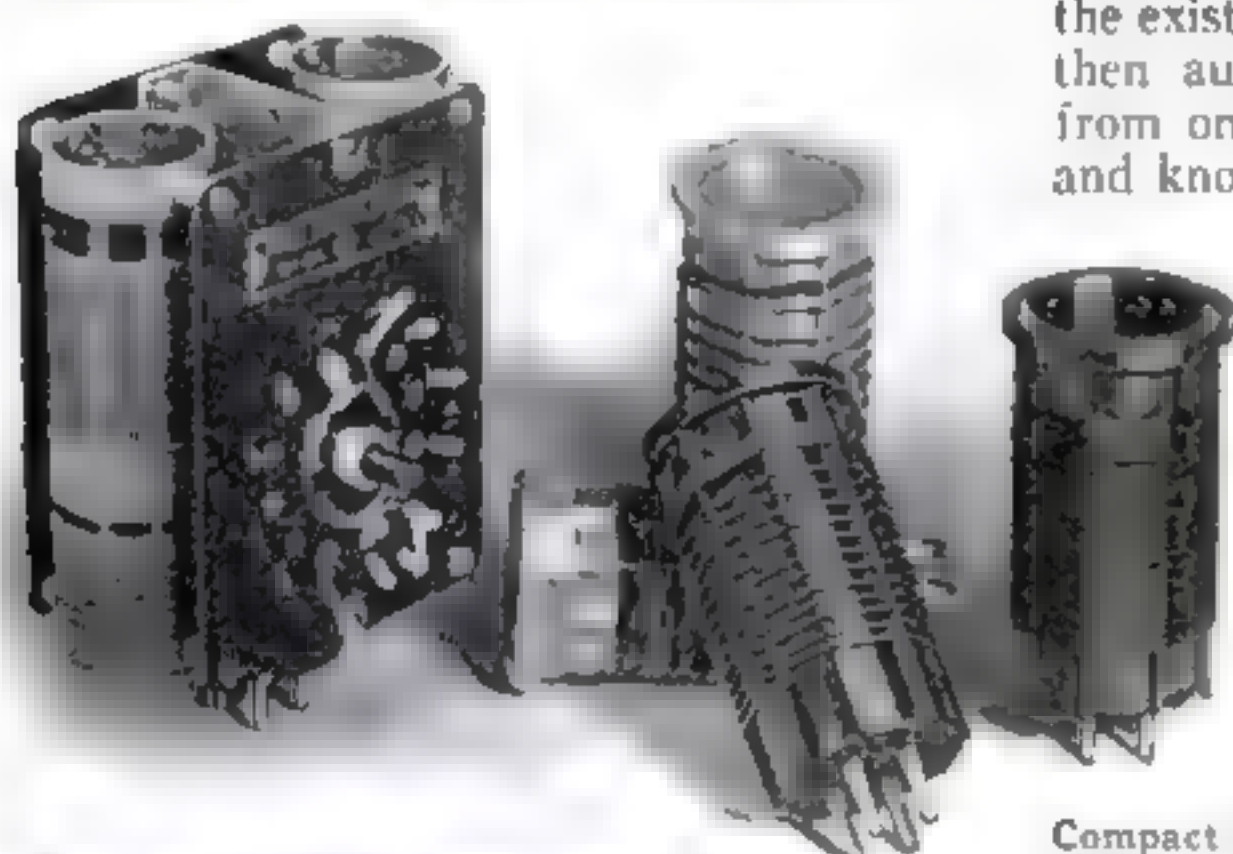
The springlike construction of this novel auto antenna eliminates loose, dangling wires. Oil-cloth covers protect the wires from the dirt

### Switching Unit Combines Four Short-Wave Coils

FOR THOSE who dislike the bother of changing coils in a short-wave receiver, a compact switching unit that combines all

four short-wave coils has recently been placed on the market. Provided with a four-prong base, it is simply plugged into the existing coil socket. A turn of a switch then automatically changes the receiver from one band to another. A fiber shaft and knob supplied with the unit make it possible to control the band switch from the front panel of the receiver. The built-in coils cover the wave bands from sixteen to 550 meters when used in a receiver equipped with a 140-mmfd. tuning condenser. A unit like this one will save a lot of time in jumping from one wave band to another.

Compact coil-switching unit for short-wave receivers, shown with the four separate coils that it replaces. It is plugged into the existing coil socket and controlled from the panel



### Name Plates Made With Individual Letters

AMATEURS no longer need go to the expense of having special station name plates stamped out for use on transmitter panels. Individual letters and separate end pieces are now available that make it easy to assemble an attractive plate.



Six separate doublets give this aerial a wide frequency range of from four to 2,100 meters

### All-Wave Antenna Requires Little Space

BUILT along the "spider-web" lines of transoceanic antennas, a new aerial for amateur use requires only a span of thirty-eight feet and a clearance of twelve feet. Consisting of six separate doublets and covering the wide frequency range from four to 2,100 meters, the antenna is designed for general all-wave use. The unit comes completely assembled and soldered for quick and easy installation. Any noise picked up by the transmission-line lead-in is balanced out in a thoroughly shielded antenna coupling transformer supplied with the kit.

## SIX NEW HELPS FOR

# Radio Builders

### Tool Has Test Light

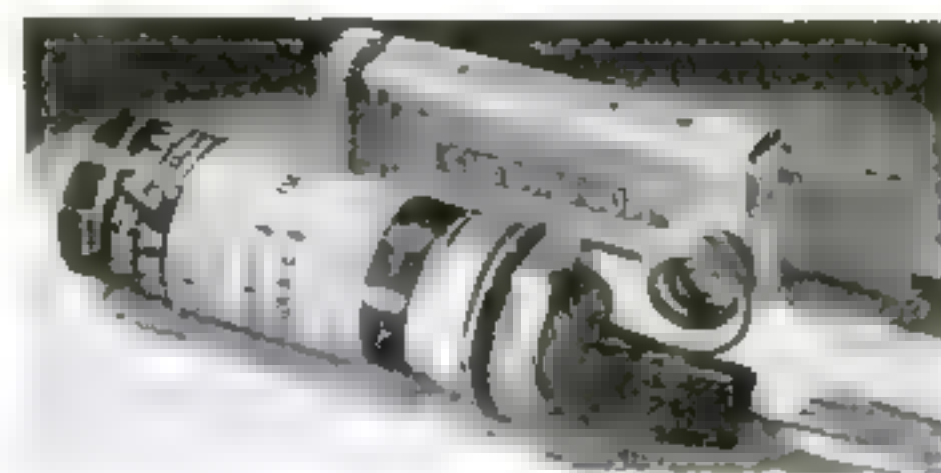
A TINY neon light concealed in its handle makes this pocket screw driver a particularly handy tool for the radio ham. It can be used for tuning transmitters to resonance and is extremely valuable for testing spark-plug suppressors in car-radio work. Should the neon bulb burn out, the tube can be replaced easily by simply unscrewing the cap on the handle.



Pocket screw driver with neon tube for testing. The bulb is easily replaced if it burns out

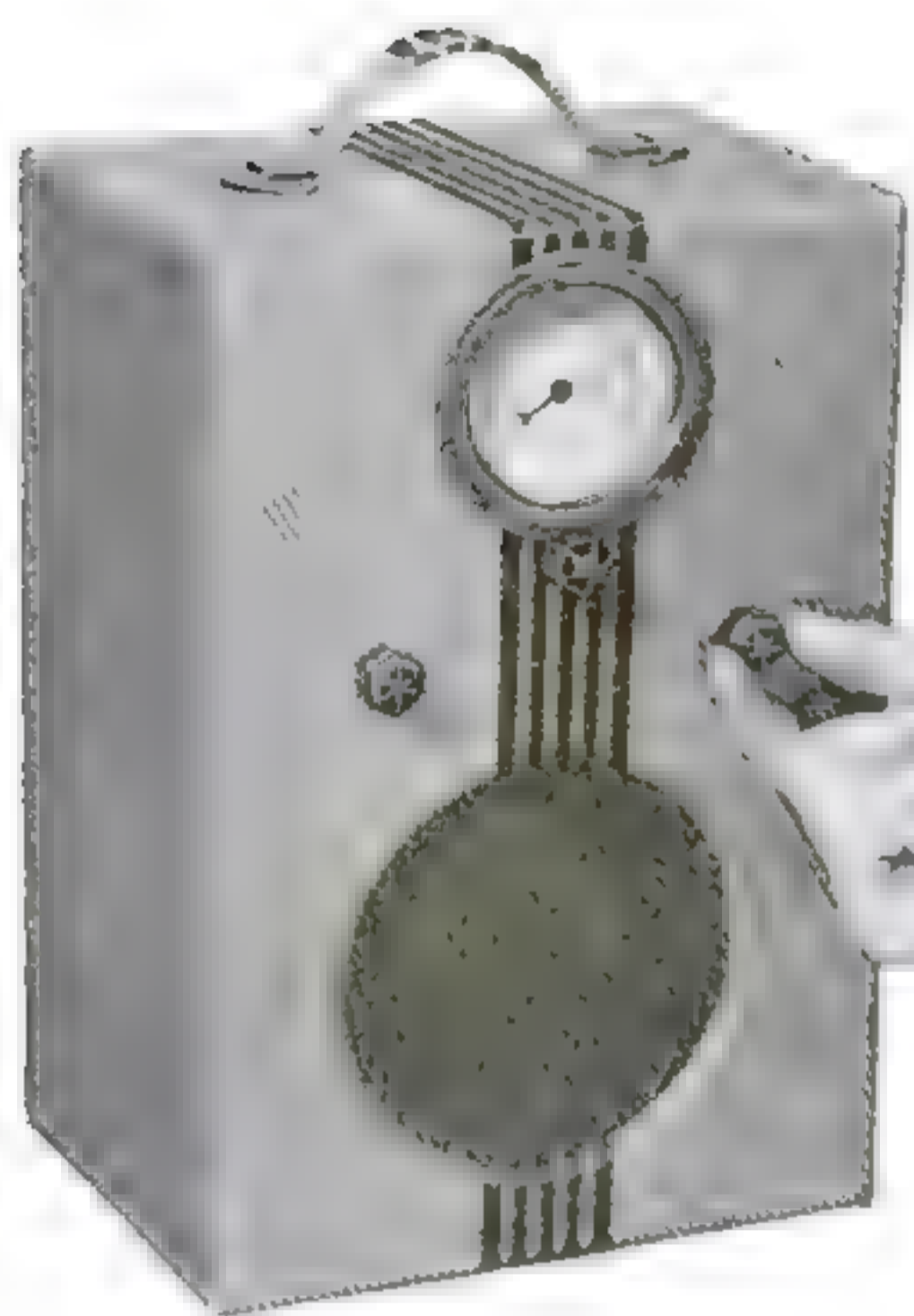
### New Midget Condenser

PACKED with twice as much capacity as ordinary condensers of the same physical size, a new, compact electrolytic unit makes it easy to cram efficient filter circuits into crowded radio cabinets. The eight-microfarad condenser shown below compared with a package of chewing gum measures only one inch in diameter and is correspondingly short.



ANYONE CAN  
BUILD THIS

# Picnic Portable



Covered with a special canvas luggage cloth, the compact cabinet is attractive and sturdy as well.

**F**OR "radio-equipped" picnics and fall outings, the compact portable broadcast receiver illustrated provides a lightweight set that operates equally well indoors or out, in a car or a canoe, and on headphones as well as with a loudspeaker. Although small, it is a battery-powered, four-tube superheterodyne that will rival the reception of any small all-electric receiving set.

Aside from its good tone and volume, it boasts another important feature where battery circuits are concerned—low current requirements, which mean long battery life. With a total "A" drain of only three tenths of an ampere and a "B" drain of eight milliamperes, its batteries will last for weeks under normal conditions of use. Two switches built into the circuit

remove any possibility of any current loss when the set is not in use.

Making use of the latest two-volt tubes, the receiver consists of a 1A6 first detector, a 1A6 oscillator, a 1A4 intermediate-frequency amplifier, a 1B4 second detector, and a 1F4 final output stage. Because it is more economical, a type '33 tube can be substituted for the 1F4 if desired. If this is done, however, an additional 7½-volt battery supply must be added to provide the necessary grid bias for the tube.

The parts, exclusive of tubes, cabinet, and speaker, can be purchased for less than eight dollars from any large radio-parts supply house. No special parts are used. In the original set shown, excellent

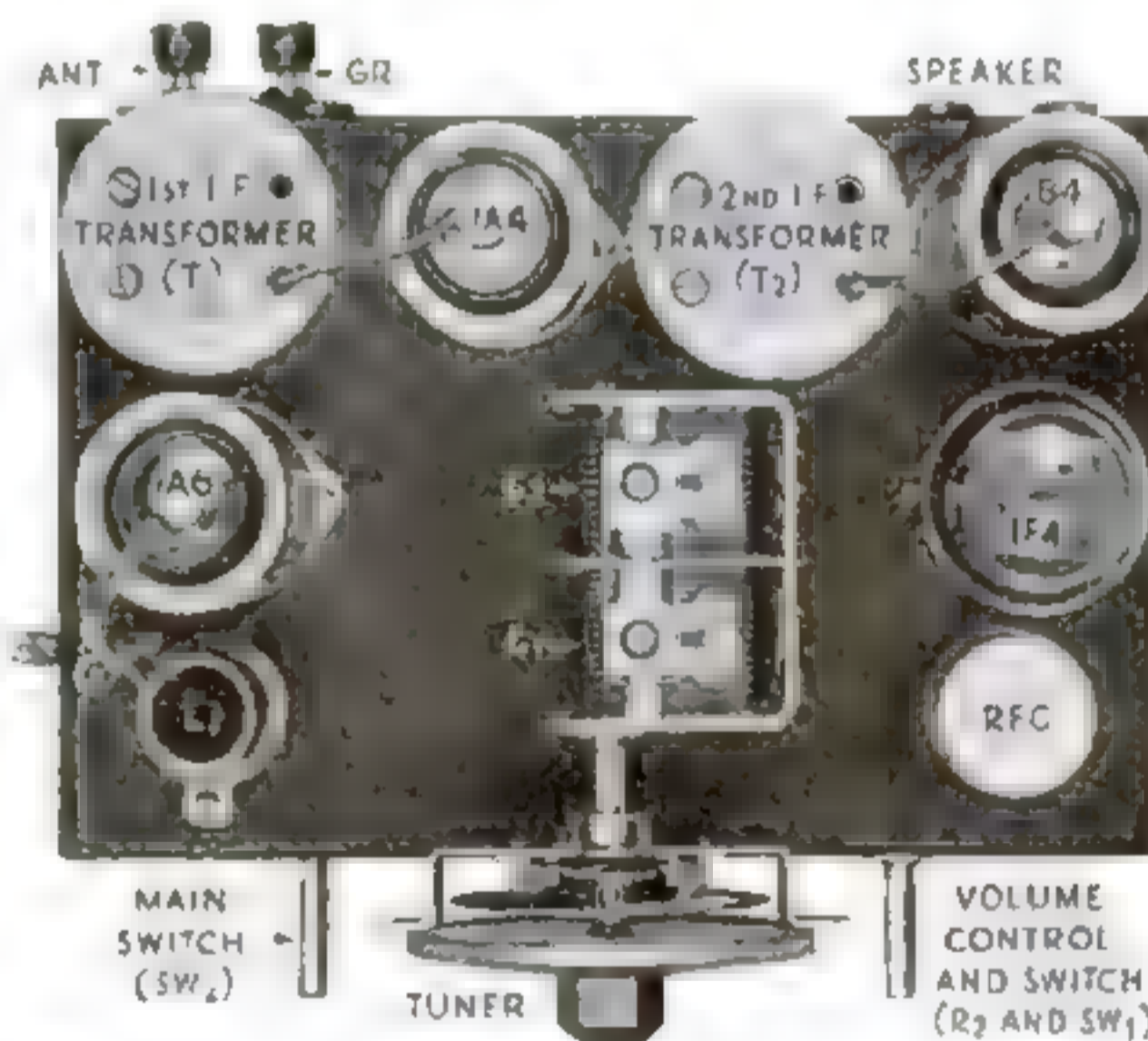
results were obtained with a 6½-inch, permanent-magnet dynamic loudspeaker. If the 1F4 output tube is used, the speaker should be designed to work with a primary load impedance of 16,000 ohms. With a type '33 tube, the speaker should be designed to work with a primary load impedance of about 8,000 ohms.

Due to the close proximity of the batteries and speaker to the circuit, a good radio-frequency filter is a necessity in compact portable receivers, if feed-back and distortion are to be prevented. In this hook-up, great care was taken in designing the audio circuit, with the result that perfect stability and tone quality have been obtained in spite of the fact that the set can be used without a ground.

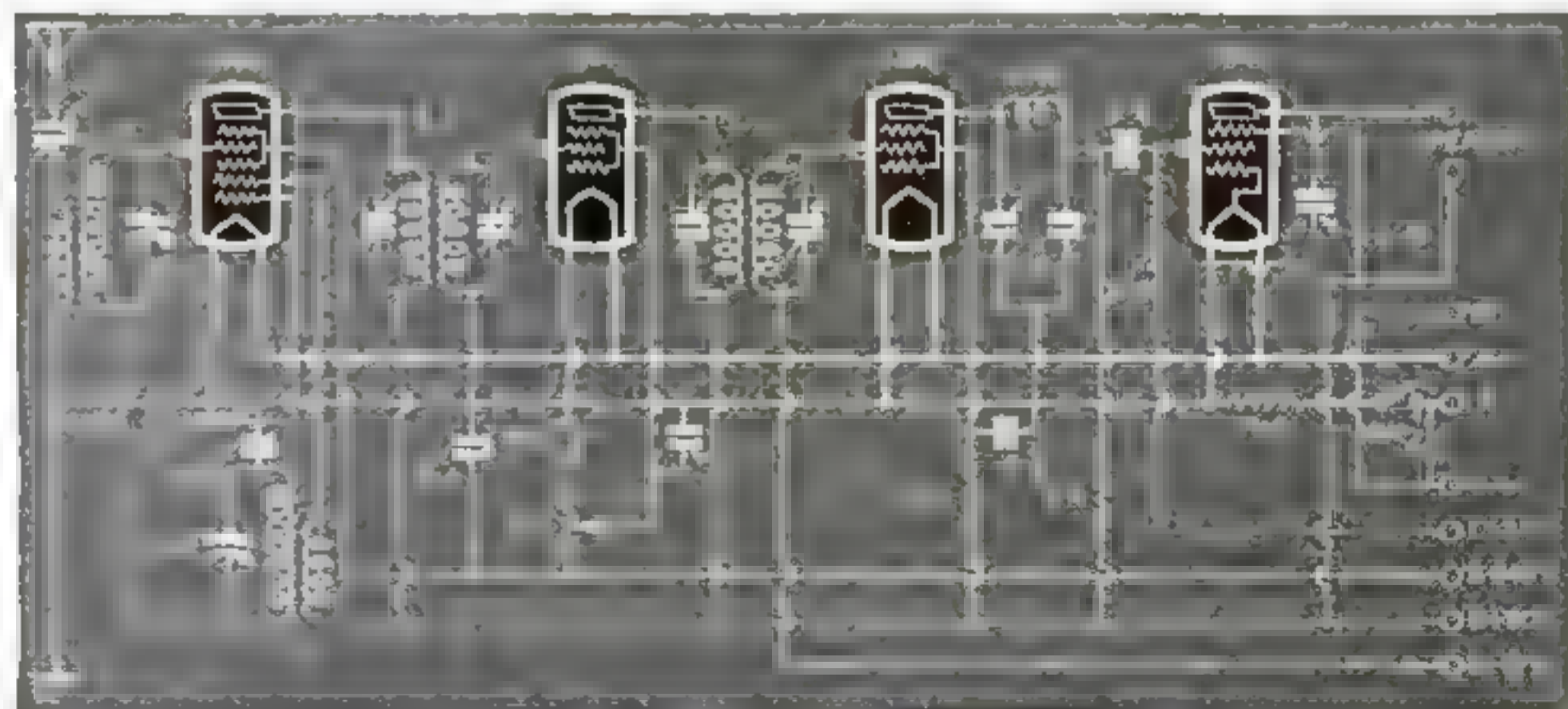
In wiring the set, special care should be taken in connecting the coils ( $L_1$  and  $L_2$ ) and intermediate-frequency transformers ( $T_1$  and  $T_2$ ). The four leads from the transformers should be wired as follows: The yellow wire on the top of each transformer should be connected to the grid of the next tube; underneath the chassis, the blue wire should be connected to the plate of the preceding tube, the black wire to -A in the case of the first transformer and to -1½ volts in the second, and the red wire to +B.

The remainder of the wiring is straightforward and no more complicated than for a simple receiver. If the parts are laid out on the chassis in the arrangement shown in the photo-

Top view of the chassis, to show positions of tubes and condensers. As indicated by the wiring diagram below, the circuit is simplicity itself.



By plugging in earphone tips in the rear, as illustrated above, the receiver may be used with a head set. Another slot in the rear cover provides easy access to the terminals for the antenna and ground.



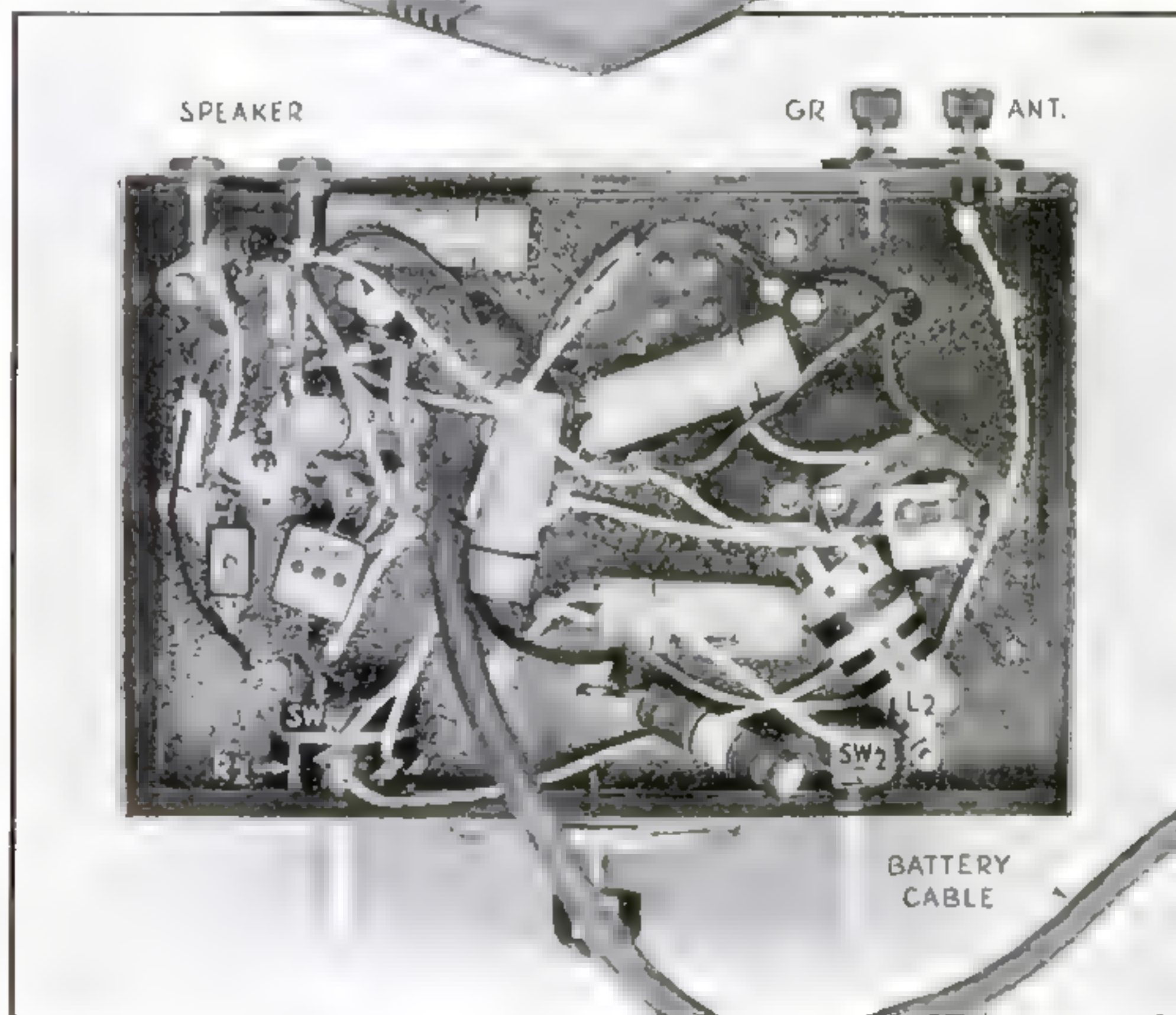
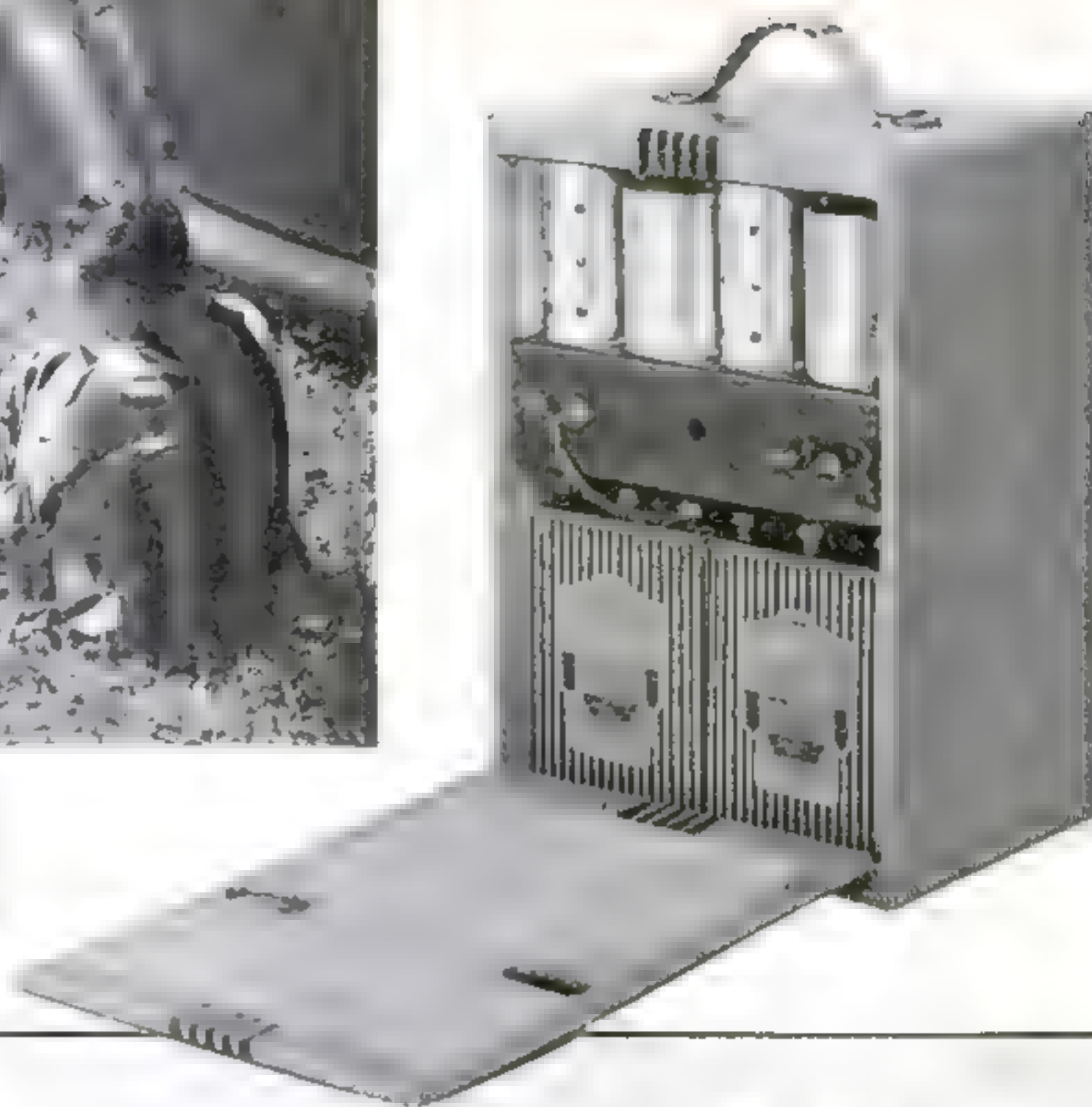


The set in use on a picnic. At right, the rear cover is opened to show the arrangement of the parts

graphs, the various connections can be made with a minimum of wire and solder.

Five batteries—two portable forty-five-volt "B" batteries, two  $1\frac{1}{2}$ -volt dry cells, and one  $4\frac{1}{2}$ -volt "C" battery—make up the power supply. An eight-wire battery cable provides a convenient means of connecting the batteries into the set.

As in all superheterodynes, the intermediate-frequency transformers must be adjusted after the circuit is completely wired. Although better results will be obtained if regular test equipment is used, these adjustments can be made by ear. Simply set the circuit in operation, tune in the loudest, near-by station whose approximate location on the dial is known, and then carefully adjust the two screw controls on the top of each transformer can for maximum volume. A fiber-shank screw driver should be used in making the adjustments. The same procedure can be followed in adjusting the padding or trim-



Underside of chassis. In wiring, special care should be taken in connecting the coils and intermediate-frequency transformers, and the latter must be adjusted after the circuit has been wired

## LIST OF PARTS

- C and C<sub>2</sub>—Variable condensers (two-gang) designed for use in a 465 kc. superheterodyne
- C<sub>3</sub>—Condenser, fixed, mica, .0001 mfd
- C<sub>4</sub>, C<sub>5</sub>, and C<sub>6</sub>—By-pass condensers, .1 mfd.
- C<sub>7</sub>—Condenser, fixed, mica, .0005 mfd
- C<sub>8</sub> and C<sub>10</sub>—Condensers, fixed, mica, .001 mfd
- C<sub>9</sub>—Condenser, fixed, .02 mfd.
- C<sub>11</sub>—Antenna trimmer condenser, .0001 mfd
- R—Resistance, fixed, 50,000 ohm, 1 watt
- R<sub>1</sub>—Volume control with switch, 100,000 ohm.
- R<sub>2</sub>—Resistance, fixed, 1 megohm, 1 watt.
- R<sub>3</sub>—Resistance, fixed, 250,000 ohm, 1 watt.
- R<sub>4</sub>—Resistance, fixed, 500,000 ohm, 1 watt.
- R<sub>5</sub>—Filament resistance, 3 ohm, 10 watt.
- L<sub>1</sub>—Antenna coil.
- L<sub>2</sub>—Oscillator coil, 465 kc.
- T<sub>1</sub> and T<sub>2</sub>—Intermediate-frequency transformers, 465 kc.
- R. F. C.—Radio-frequency choke, 80 mhy.
- Miscellaneous.—Chassis, cabinet, tubes, speaker, batteries, dial, knobs, binding posts, tip jacks, terminal strips, one six-prong socket, one five-prong socket, two four-prong sockets, battery cable, connecting wire, one rotary switch, solder, etc.

*Note:* If a type '33 power pentode tube is used in place of the 1F4, the following changes in the specifications of the parts must be made: a two-ohm instead of a three-ohm filament resistor, and a  $7\frac{1}{2}$ -volt instead of a  $4\frac{1}{2}$ -volt "C" battery.

mer condensers located on the top of each tuning condenser in the two-gang unit.

Although the 7 by  $9\frac{1}{2}$  by  $13\frac{1}{2}$ -inch cabinet can be made easily by anyone handy with tools, I found that for very little more than the cost of materials I could have a case made to order at a neighborhood trunk shop. Covered with special canvas luggage cloth, it is not only attractive but sturdy. Two slots cut in the hinged rear cover provide easy access to the antenna and ground terminals and to the combination speaker-earphone plugs.

No shelf is used to hold the chassis in the cabinet. Four bronze speaker bolts passed through holes in the sides of the

chassis and cabinet and fastened with nuts hold the circuit firmly in place.

Although a ground terminal is provided, the receiver will operate efficiently without any outside connection to the ground. The antenna need be nothing more than a twenty-foot length of wire stretched on the grass or laid along the bottom of a canoe. If a longer antenna is used it will be necessary to install a trimmer condenser in the antenna lead as shown in the diagram. This can be mounted at the rear of the cabinet. If this condenser is built into the set at first, as is provided for in the hook-up, the antenna length can be increased at any time.

# Common Sense Makes Good Drivers

By MARTIN BUNN

**B**ARRY PENDLETON turned his car in at the Model Garage, slammed on the brakes with a savage jerk, climbed out, and glared angrily at the badly crumpled front fender of his new coupe.

"Smacked somebody, eh?" asked Gus Wilson, mechanic of the establishment, as he bent over and ran his huge, gnarled hand lightly over the indentations.

"I did not!" Pendleton denied, heatedly. "The darned idiot cut in on me. That's the fourth time this year somebody's slammed into my car, and I'm getting sick of it. Next time, I'm going to hand whoever does it a swift sock in the jaw—and I don't mean maybe!"

"But supposing you were to blame—like this time?" chuckled a man whose car had pulled in and stopped behind Pendleton so quietly that he hadn't heard it. "It'd kind of make the fellow extra mad to punch him after running into him, wouldn't it?"

"Say! Where do you get that stuff?" Pendleton snapped at the newcomer. "Didn't I say he cut in on me?"

"Maybe he did," replied old Thaddeus Hunter, as he leaned his six feet of skinny height against his sedan, "but that doesn't give you a license to ram him. That dent never came from a side-swipe—did it, Gus?"

"Couldn't have," growled Gus, between thumps with a fender hammer as he gradually raised the dent. "See where the bottom of the dent is. Nothing coming from the side could have got there without bending in the side first."

"Well, maybe he didn't actually hit me," Pendleton reluctantly admitted. "But he pulled in so quick that I couldn't help but hit him."

"That doesn't sound right, either," the older man argued. "When a fellow passes you, he's going faster than *you* are. But you must have been going faster than *he* was, else you couldn't have hit him. How do you figure that out?"

"He wasn't trying to pass me," Pendleton explained. "The dumb-bell was driving right out in the middle of the road, so I thought I'd shoot by on the inside. Just as I got nearly up to him, he swung over toward the edge of the road, for no reason at all. Naturally, I hit him. How could I help it?"

Hunter chuckled. "Young man, if all the motorists who've got into trouble from trying to pass on the wrong side were laid end to end they'd reach from

here up to the north pole and down the other side 'most to China, I reckon."

"All right, go ahead and kid me if you get any fun out of it," growled Pendleton, "but just wait till I catch you after a smash and I'll hand it all back to you."

"Guess you'll have to wait quite a while for that come-back," Gus grinned, as he squinted along the line of the dent to note his progress. "Hunter hasn't had a real accident in the thirty years he's been driving a car, and he hasn't even so much as dented a fender in a dog's age."

"Thirty years!" Pendleton exclaimed. "You were driving a car over five years before I was born. Then you don't drive many miles a year, or else you'd have accidents the same as other people."

"Other people don't all have accidents," Hunter corrected. "Thousands of 'em can show just as good a record as mine. Trouble is," he continued, poking at the end of his stogy to keep it from burning up one side, "the people that have accidents have forgotten what automobiles are for. They can't seem to remember that getting there safely is the first object. And that's just a matter of applying common sense to your driving."

"I've got just as much common sense as anybody," Pendleton growled.

"Sure you have," agreed Hunter. "Only, are you sure you use it? A while back, you said the fellow you bashed into was a dumb-bell because he drove way out in the middle of the road. Maybe he was, but if a fellow is so dumb he doesn't know enough to stay over on his own side of

the road, then your common sense ought to tell you he's likely to do almost any other dumb trick on the calendar."

"But common sense isn't everything there is to driving, by a long shot," Pendleton interrupted. "How about skill, and good eyesight, and muscular coördination, and knowing just how fast you can go around curves without skidding, and that sort of thing? Aren't they just as important as common sense?"

"Not by an oversize jugful!" Hunter replied, emphatically. "Say, Gus, how long will it take you to finish that fender?"

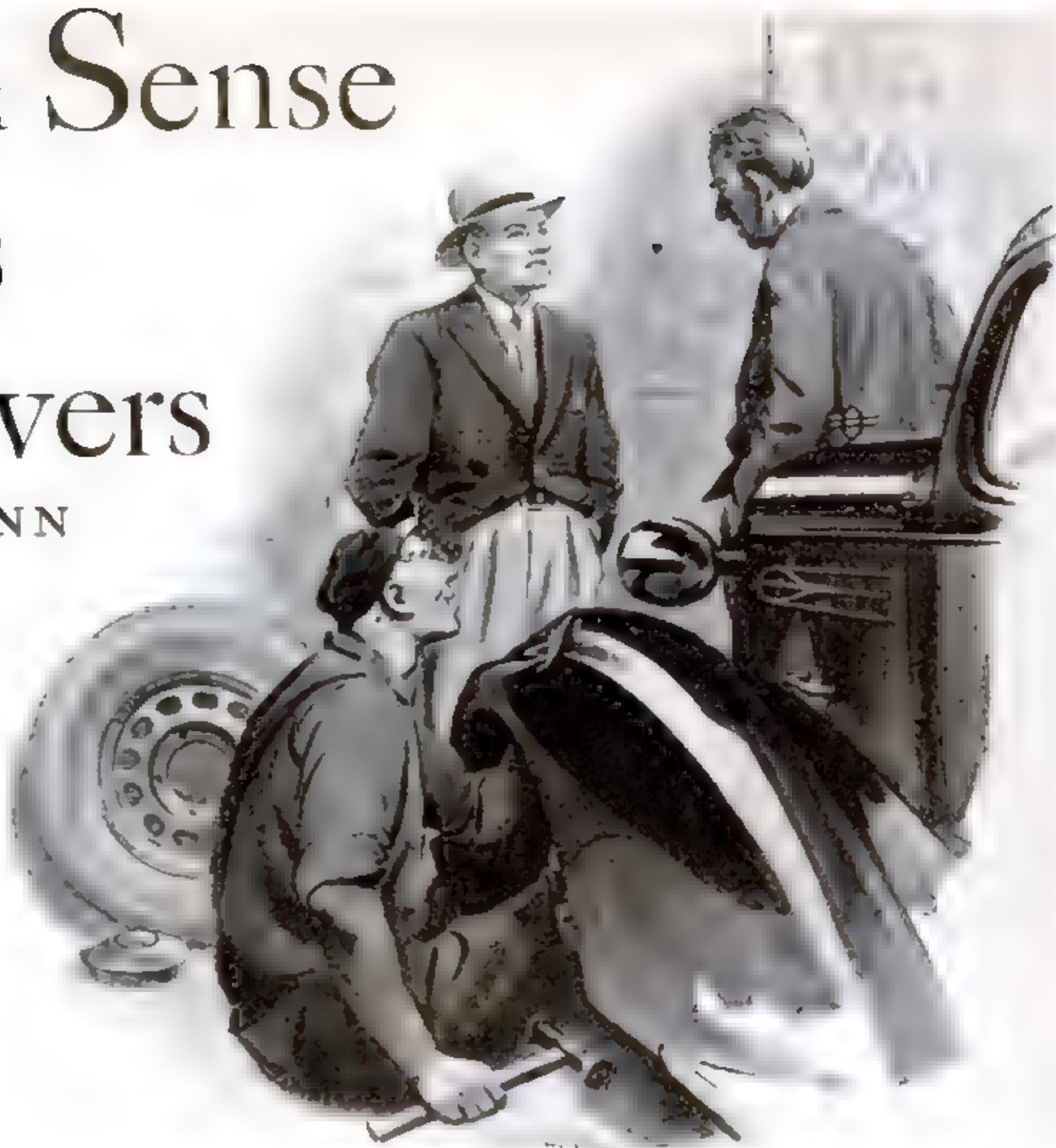
"An hour, at least," Gus replied, as he adjusted a rubber-backed grinding disk on the end of his flexible shaft. "It's got to have a couple of coats of lacquer sprayed on after I get it flattened out smooth."

"Then, young fellow," Hunter suggested, "suppose you drive with me over to the lumber mill in Pineville and back while Gus finishes your bus. Maybe I can show you why no amount of plain skill can make up for lack of common sense and good judgment."

Pendleton was willing. As he climbed in beside Hunter, the latter craned his thin neck first one way and then the other to get a clear view of the road both ways before he let in the clutch.

"No skill required there," the older man observed, as they backed out, turned, and started down the road. "Just common sense tells you to make sure there's nothing in the way when you back out or even start up from the curb."

"I always (Continued on page 113)



"Maybe he did cut in on you," replied Hunter, "but that doesn't give you a license to ram him."

# THE HOME WORKSHOP

ANY HUNTER CAN MAKE  
HIS OWN LIGHTWEIGHT

## *Silhouette Decoys*

Cut from wood or sheet metal and painted, they successfully attract ducks, geese, crows, and snipe



Simple and inexpensive as they are to construct, good silhouette decoys lure many birds to a hunter's blind

By MAURICE H. DECKER

CAMPING AND WOODCRAFT EDITOR  
OF 'OUTDOOR LIFE'



Mallard duck decoys of the silhouette type. They are popular because they will attract other species as well



**D**ECOYS are an important part of the bird hunter's outfit. The silhouette type is light to carry and has proved very successful for hunting ducks and geese. More will be used this fall than ever because live decoys are prohibited. Silhouettes are also used almost exclusively in shooting crows, and recently snipe hunters are using them to lure these fast, zigzagging birds within gun range.

Any hunter can make his own silhouette decoys at low cost. First lay off a block of 1-in. squares on a sheet of cardboard and draw life-size patterns of the types you wish to make. The drawings, when enlarged as indicated by the squares, are slightly oversize because a large decoy draws better and is more easily seen by the game. Cut your patterns out and sand the edges to remove scissors marks. Use them as templates to mark the material.

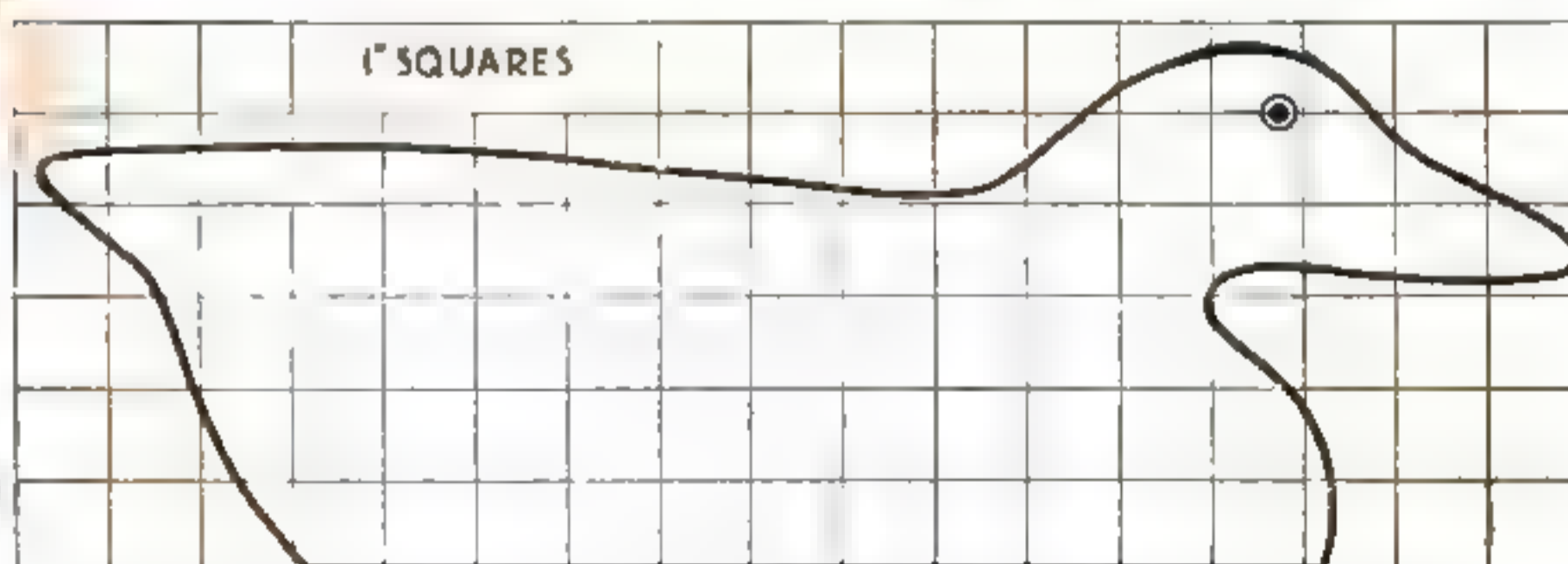
Thin lumber or  $\frac{3}{8}$ -in.

plywood is suitable for ducks and geese,  $\frac{1}{4}$ -in. plyboard or sheet metal for crows, and sheet metal for snipe. If you have a band saw, you can cut out six or eight silhouettes at one operation. Lacking power tools, use a keyhole, coping, or compass saw for wood. Curved-blade tin snips or metal-cutting jig saws will serve for metal silhouettes. File all sharp edges away to prevent cutting your hands. Be sure to manufacture enough decoys of each species. Larger groups always draw more game.

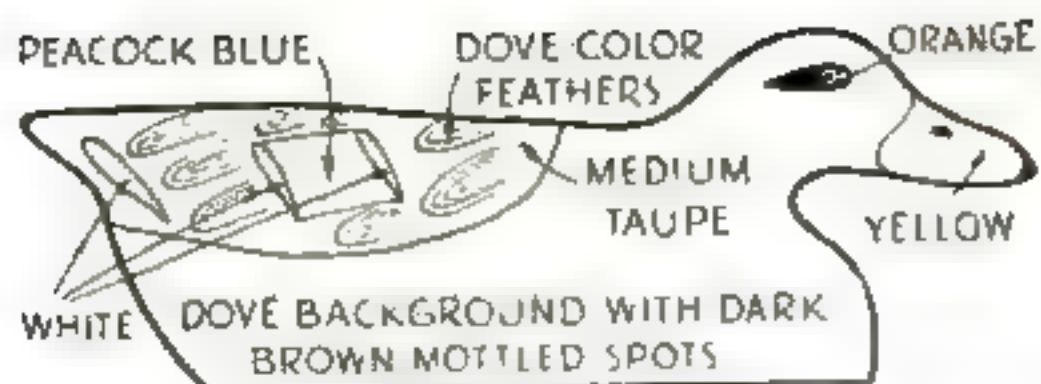
Sand the edges of the duck silhouettes smooth, and round off the edges around head and bill. Duck silhouettes can be provided with long wire or wooden legs, but the best plan is to use the float shown on the following page. Note how each silhouette is clamped in the sawed slot with a bolt and wing nut, and also how two floats are joined with a crosspiece and bolts so the decoys can be shifted backward or forward to change their relative positions. Wing nuts enable you to disassemble the float quickly for packing. Provide a cord and weight to anchor the float at the chosen location.

In setting out duck silhouettes, place them crosswise to the wind. Ducks usually decoy towards your blind into the wind and thus get a full-width view of the silhouette as they approach.

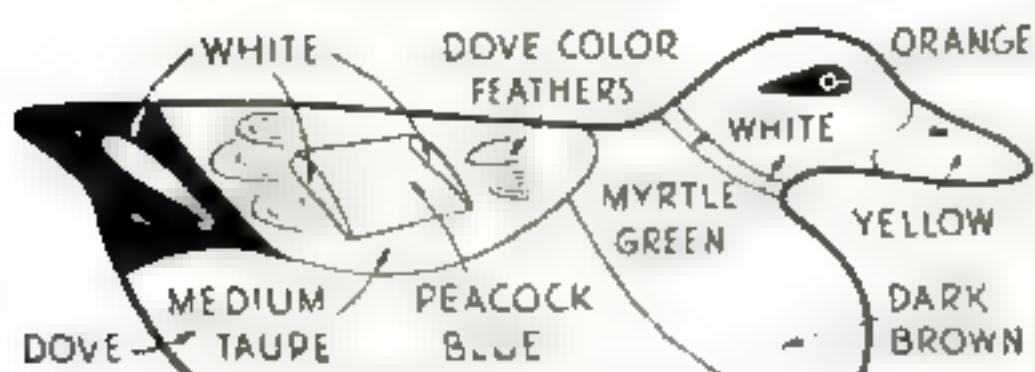
Don't let the coloring dismay you. It is not necessary to be an artist to paint silhouettes that draw game well. I have



To make a duck pattern, draw 1-in. squares on a piece of cardboard and copy this drawing, line for line. At the left are half a dozen duck decoys, band-sawed at one time

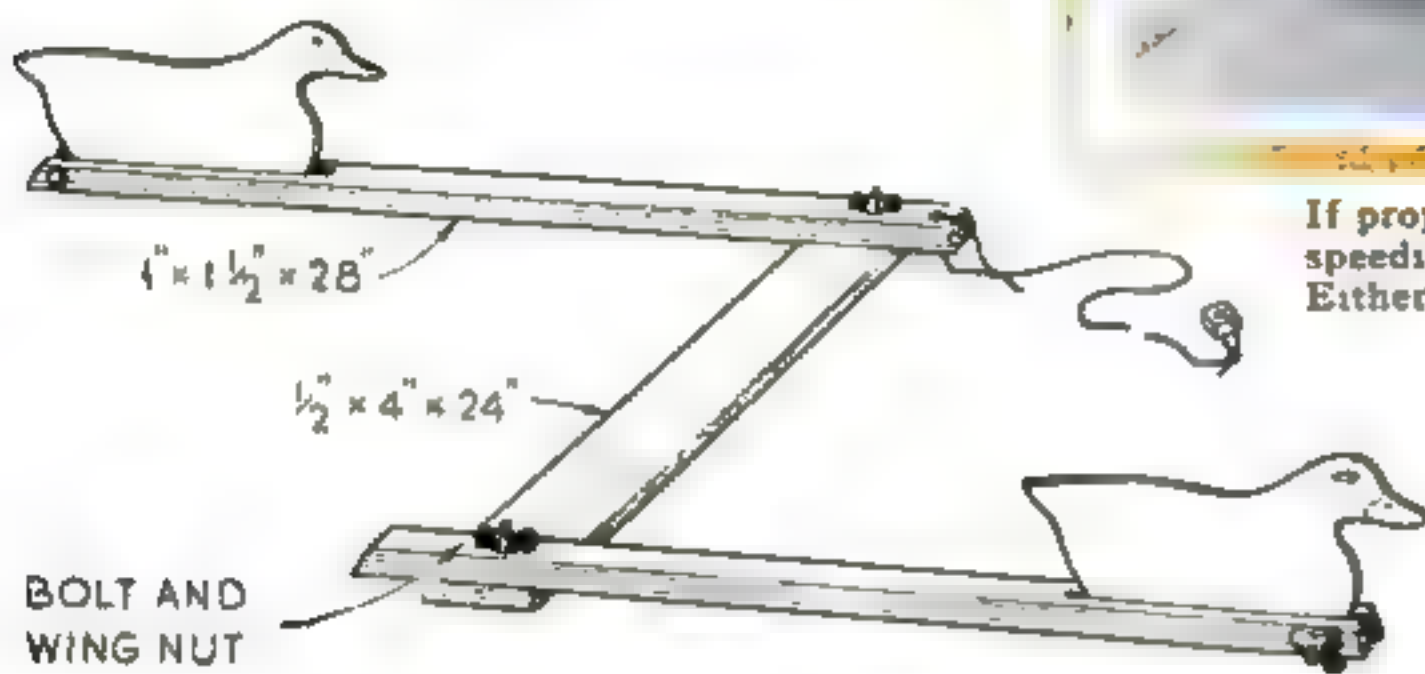


MALLARD HEN



MALLARD DRAKE

Color charts for painting mallard decoys. The feather markings are combed into the wet paint



Collapsible float. The 24-in. connecting strip can be moved away from, or closer to, the ends of the other pieces to make the decoys float properly

shot many ducks over poorly colored decoys, and if you get the colors approximately right, the result will be good. Give all wooden decoys a preliminary coat of shellac to seal the wood.

Mallard painting is popular with duck hunters because it will draw other species of ducks also. To paint twelve duck silhouettes, you will need 1 pint of white and  $\frac{1}{2}$  pint each of dark brown, black, colonial yellow, shutter green, bright blue, and silver gray. Use oil paint or quick-drying enamel, but if enamel is used it should be rubbed with pumice and water when dry to dull its shine slightly, otherwise the decoys may glare too much in the sun. You should have a No. 1 water-color brush for the eye rings, and a

$\frac{3}{4}$ -in. varnish brush for the body colors.

Prime the ducks all over with one coat of white. Charts are given to indicate the colors and their locations for both the mallard drake and the hen. Paint the lower body of the drake a dove color, made by mixing some white and a very little brown with silver gray. Add a little black to the shutter green and paint the drake's head. Mix a little dark brown with silver gray to get the medium taupe of the duck's upper body and wing. Apply this medium taupe, let it dry five minutes, then put in feather markings. I used

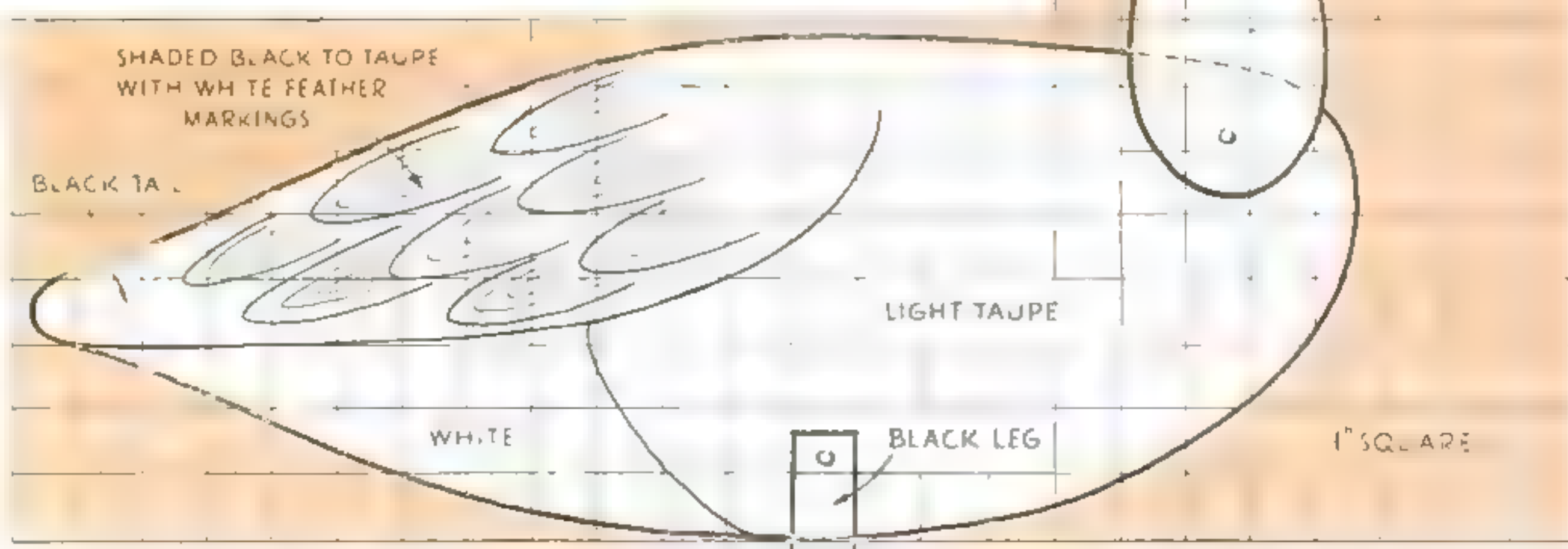
latter more nearly the true peacock blue of the mallard wing. Add the white neck stripe and white tail dash. Remember when mixing paint that it will probably dry dark, so mix somewhat lighter than you wish the finished work. Your most common mistake will be in getting the body colors too dark.

In coloring the mallard hen, paint the entire body the dove hue, then splotch it with dark brown. To make this mottled effect, put some dark brown paint on a board, take a very little of it on the end of brush, and stamp the brush down on the dove background. Don't dip the brush in the paint can for this work. Paint the hen's bill colonial yellow which has been tinted with a small amount of dark brown.

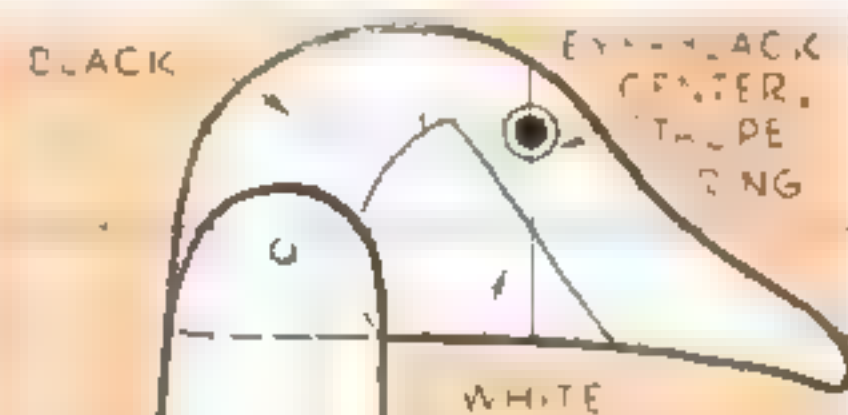
Goose silhouettes are sawed from plywood after separate patterns have been



Pattern and color scheme for goose decoys. The head, neck, and body are riveted in such a manner that the silhouette may be folded compactly for carrying, as shown in the photo above. This also enables the heads and necks to be set at different angles to make a group lifelike



Silhouette decoys for geese are set up in fields and on sand bars where the birds are likely to rest



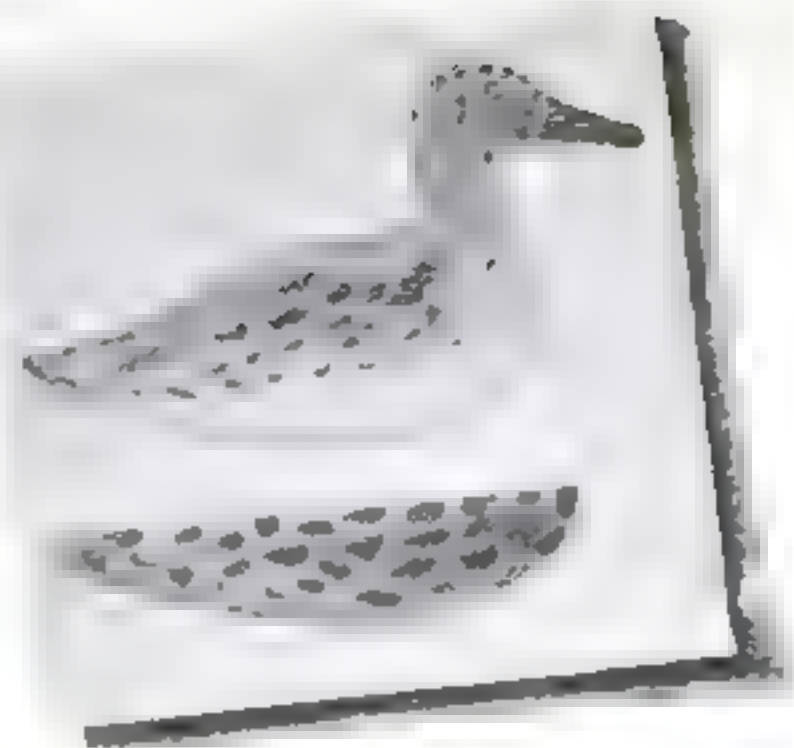
made for the body, neck, and head. The leg is plyboard, 1 in. wide by 13 long. Assemble with rivets. The silhouette then can be folded compactly for carrying and when set up, the heads and necks can be given slightly different positions to make the group more lifelike, as illustrated in a photograph on the preceding page.

For eight goose silhouettes you will need 1 pint white and ½ pint each dark brown, silver gray, and black. Prime the goose decoy with white, then paint the white lower rear body. Use a light taupe for the upper front body, obtained by mixing a little dark brown with the silver gray. Then paint the goose tail black for 2 in. and blend immediately into the taupe by brushing back and forth across the two wet colors. Apply realistic feather marks as shown.

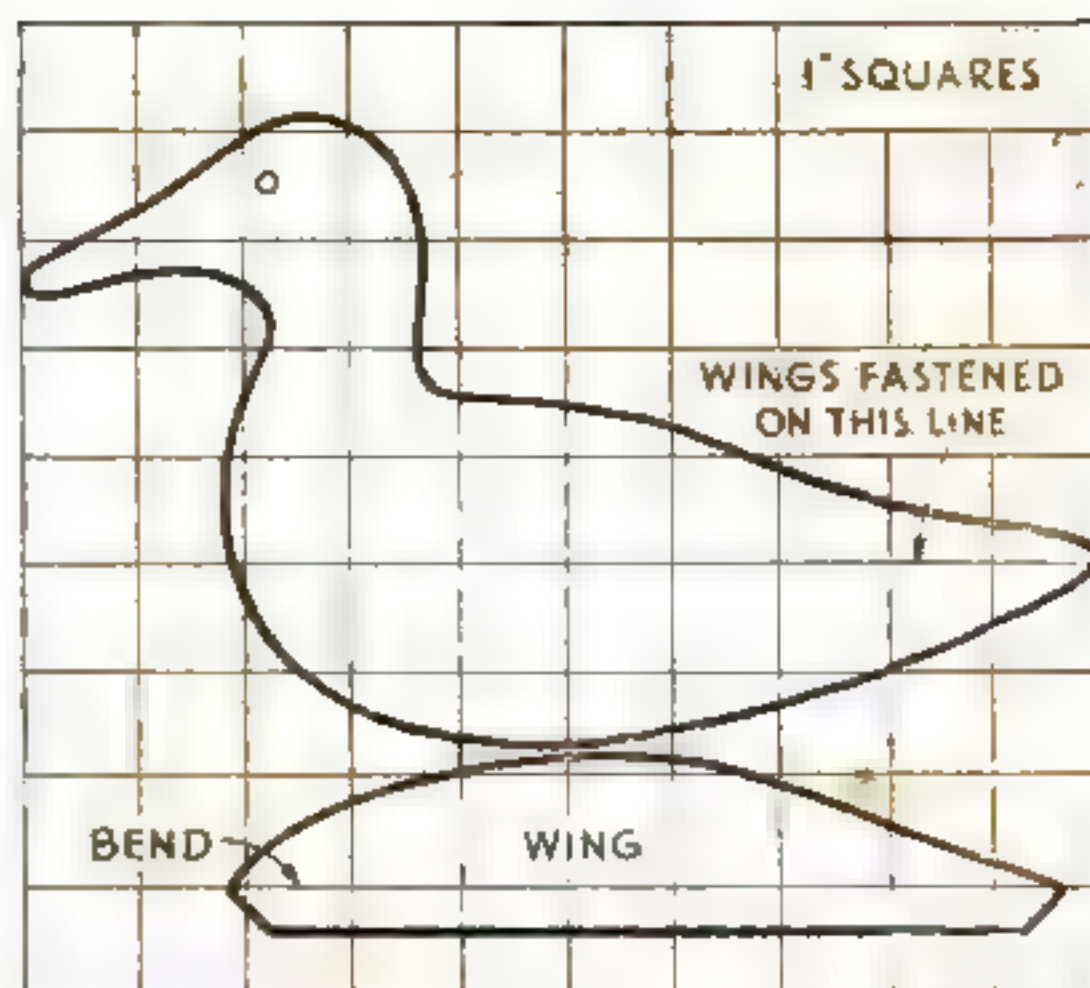
Set goose silhouettes in fields and on sand bars where the birds stop to rest and feed. The best blind is a pit dug shoulder deep in the ground and skillfully covered with some natural material. Goose hunters sometimes wear white suits like those used by surgeons in order to be less conspicuous when the ground is covered with snow.

Crow shooting is popular both as a move in conservation to preserve the eggs and young of game and song birds and also as a keen sport that tests the hunter's skill and improves his marksmanship for other game.

Effective crow silhouettes can be cut



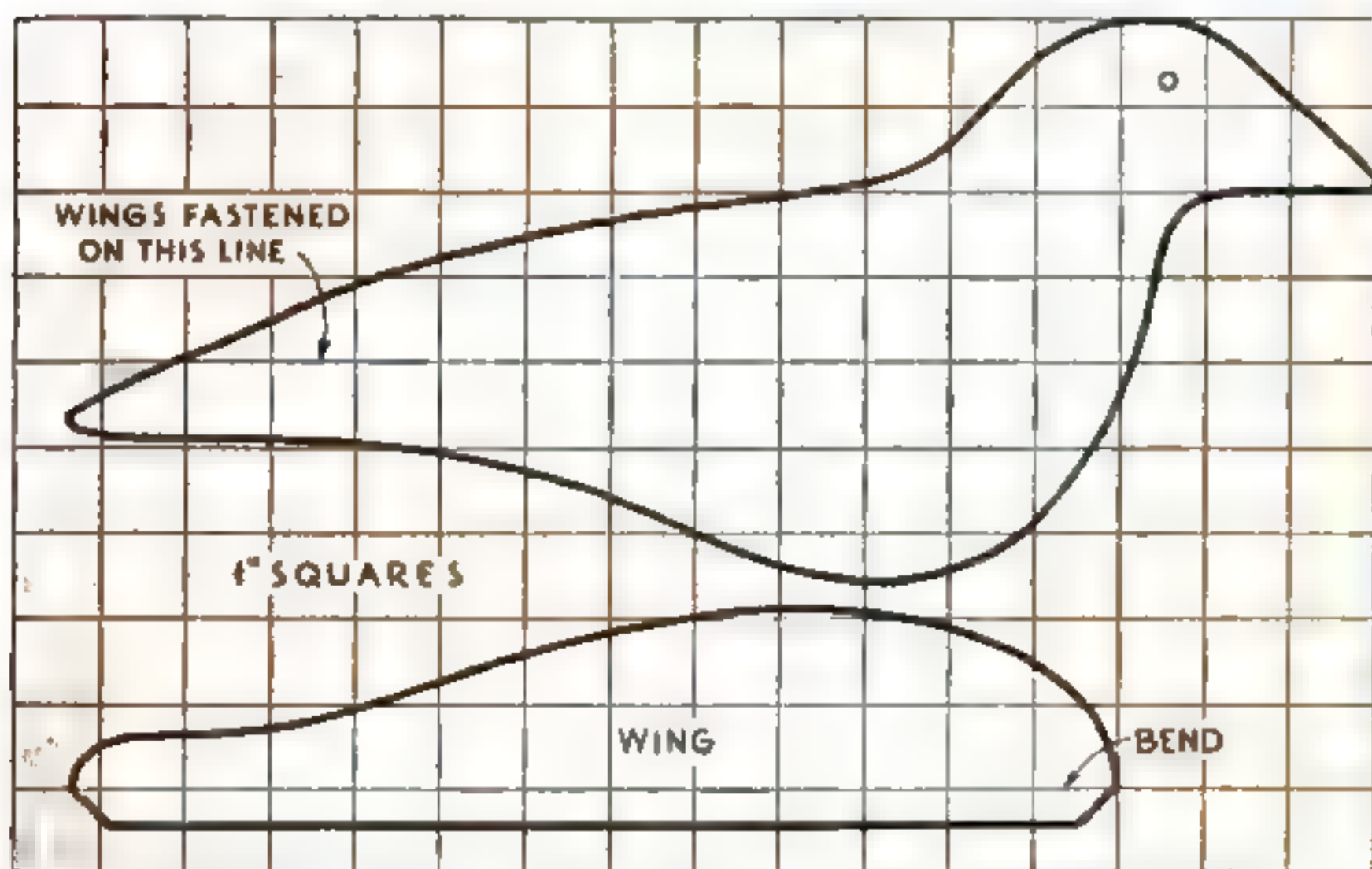
Snipe decoys are painted oyster white; then, before the color dries, mottled spots of very dark gray are blended in



Patterns for the snipe's body and wings. These parts are cut from sheet metal, and the wings are bent and riveted to the body on the line indicated. The eye is represented by a drilled hole. A leg 13 in. long is added to hold the decoy firmly when set in the mud



Snipe decoys in place. Set them on the bank or in shallow water at the edge of a marsh, lake, or ditch



Crow silhouettes may be cut from either plywood or metal. They should be placed out in a field, and the shooting done from blinds in brush-grown fence rows. At left: The patterns

## WHITTLING... fine fun for summer nights

A SHARP pocketknife and a soft pine block—that's all you need to while away many a pleasant evening hour at camp, on the beach, or even in your own back yard. In recent years there has been a distinct revival of interest in this old Yankee pastime.

One easy way to begin is to get a whittler's construction kit. Two are listed on page 92. One contains materials for whittling Skipper Sam'l, a picturesque old sea captain; the other, materials for six different Scotties. Both are accompanied by step-by-step instructions.

either from ¼-in. plyboard or metal. In either case make the wings from metal and tack or rivet them on each side of body. Drill a ⅛-in. hole clear through the material to serve as an eye. Apply two coats of dead-black paint to both sides of the decoy. Use wooden legs 7 in. long; these are shoved into the ground until the decoy is 2½ in. above the surface as shown in the photograph at the right above.

Use blinds of brush, cornstalks, or any natural material found where you shoot. Do not place crow decoys in timber. Locate them out in a field and build the blinds in brush-grown fence rows. When two men hunt together, make two blinds 35 yd. apart and place decoys at a point 30 yd. from each blind, the three locations forming a triangle. Each hunter then gets more shots at the crows without damaging the silhouettes than if both men occupied one blind. A crow call is advised be-

cause calling always brings more crows than decoys alone.

Cut snipe silhouettes from sheet metal. Rivet on the wings, drill a ⅛-in. hole for the eye, and make the legs 13 in. long to hold the decoy firmly when set in mud. Paint the entire silhouette an oyster white made by mixing a little black with white; and before this dries, put on the soft mottled spots of very dark gray (silver gray tinted with black) and blend the edges of the spots carefully with a small water-color brush. The snipe's bill is black.

When hunting snipe, set the decoys at the edge of the marsh, lake, or ditch, either on the bank or in shallow water. Choose locations where snipe have been seen to wade and feed. Your blind can be placed either up on the land or at a fair shooting range in the water, according to local conditions.

# Whirligig Turns on Old Auto Axle

ALTHOUGH it can be constructed at small cost, this combination teeter totter and whirligig rivals real playground equipment in size and durability and will give children many hours of fun.

The pivot and fulcrum bearing are made from a right-hand front wheel and axle assembly obtained from an auto-wrecking yard. Arrange to have the axle and tie-rod cut at the yard with the cutting torch, about 6 in. toward the center of the axle from the spring mounting. The hub is left intact with the exception that the outer flange is removed. The hub cap should be well packed with grease, which will provide lubrication for a long time if the retainer felts and rings on the spindle are in fair shape.

Turn the tie-rod adjusting yoke well down on the tie-rod, and with the center line of the hub lined up with the axle, mark the tie-rod to be cut off so that the end, when flattened and drilled, will fit under the head of the lower bolt of the old spring mounting, as shown in the drawing. Round off the end of the tie-rod after

the hole has been drilled, so that the rod will swing clear to fall down out of the way when the bolt holding it to the steering arm is removed. This bolt is held in place only by a cotter pin, and should work freely so that it can be easily slipped in and out.

The axle assembly is then bolted to the upright, which should be a 4 by 4-in. chestnut or yellow pine post about 3½ ft. in length. Set the post, with the axle attached, in the ground to such a depth that the spindle bolt will be about 18 in. above the surface. Tamp earth and small stones firmly around the post to make it rigid, or concrete can be poured around it.

The plank used is 2 by 10-in. yellow pine, selected for grain and soundness, and is 14 ft. long. Carefully round and smooth all edges and corners. To strengthen the plank, two 2 by 4-in. or 2 by 6-in. pieces, each 3 ft. long and cut to the bevel shown, are spiked on edge to the underside of the plank at its center. These are spaced so as to allow the hub to fit between them, and are attached

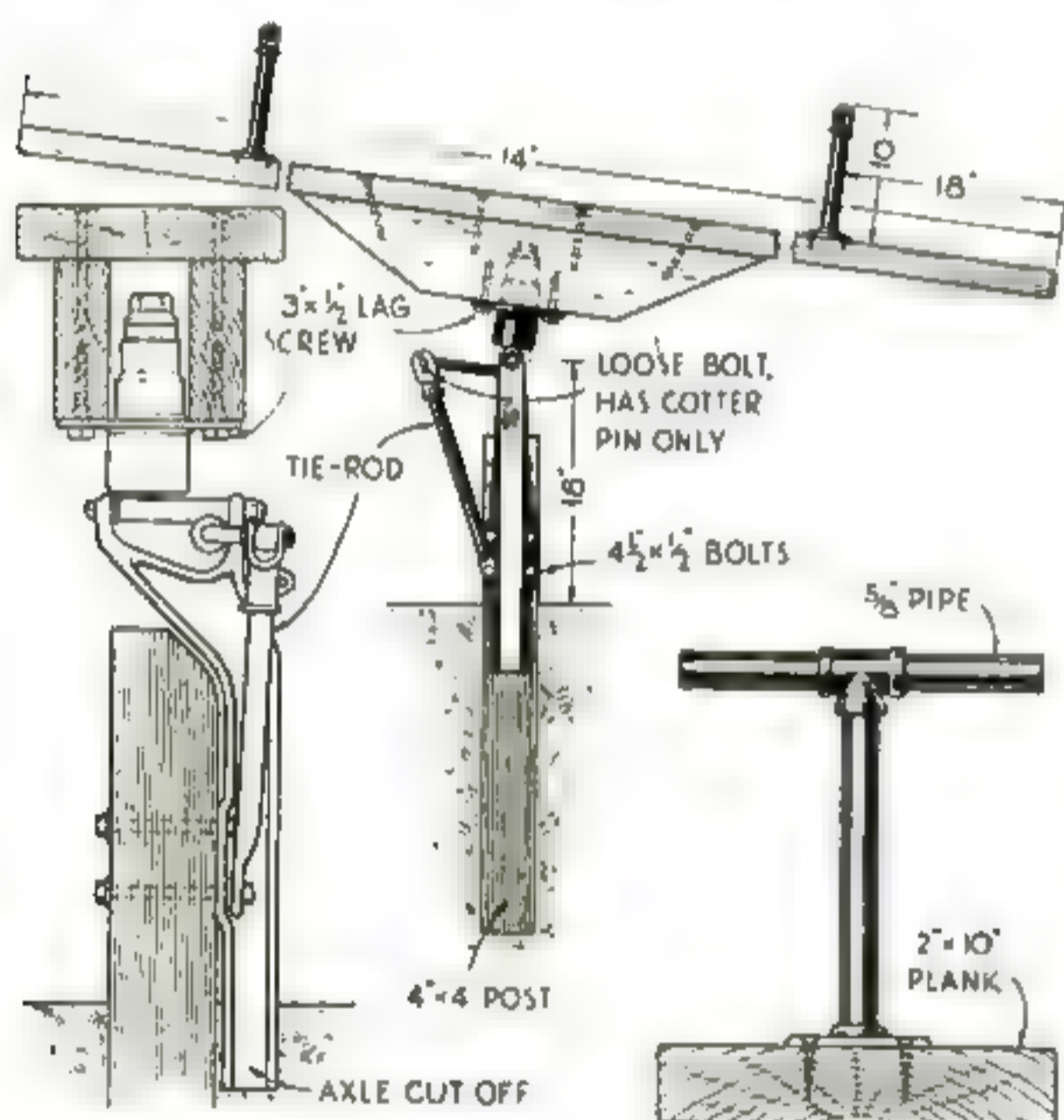
to the inner hub flange, on which they rest, with 3 by ½-in. lag screws. Handholds made from ⅝-in. pipe and fittings as shown should be placed about 18 in. from each end of the plank. Use 1½-in. screws through the pipe floor flange and into the plank, making certain that the flanges are securely fastened.

To adjust the pitch of the plank, merely turn off the yoke on the end of the tie-rod until the lower end of the plank will be close enough to the ground for a child to reach it easily with his feet in order to propel it as a whirligig. After it has been started, it can be kept in motion by bending forward or back as in "pumping" a swing. It will not take the child long to learn to lean forward as the end upon which he is sitting swings around to go up, and to lean back just as it starts to swing down. In this manner it is possible for one child alone on the plank to make it revolve at considerable speed with no difficulty at all.

To use it as a teeter totter, pull out the bolt holding the tie-rod to the steering arm, and let the tie-rod fall down out of the way. It will be found that in using it as a teeter, the plank will need to be kept about at right angles to the spindle in order to avoid its tipping sideways while in use.—ROBERT J. NYE.



Children can use this piece of playground equipment either as a teeter totter or a whirligig



How the apparatus is set up for use as a whirligig. To convert it into a teeter totter, the tie-rod is released

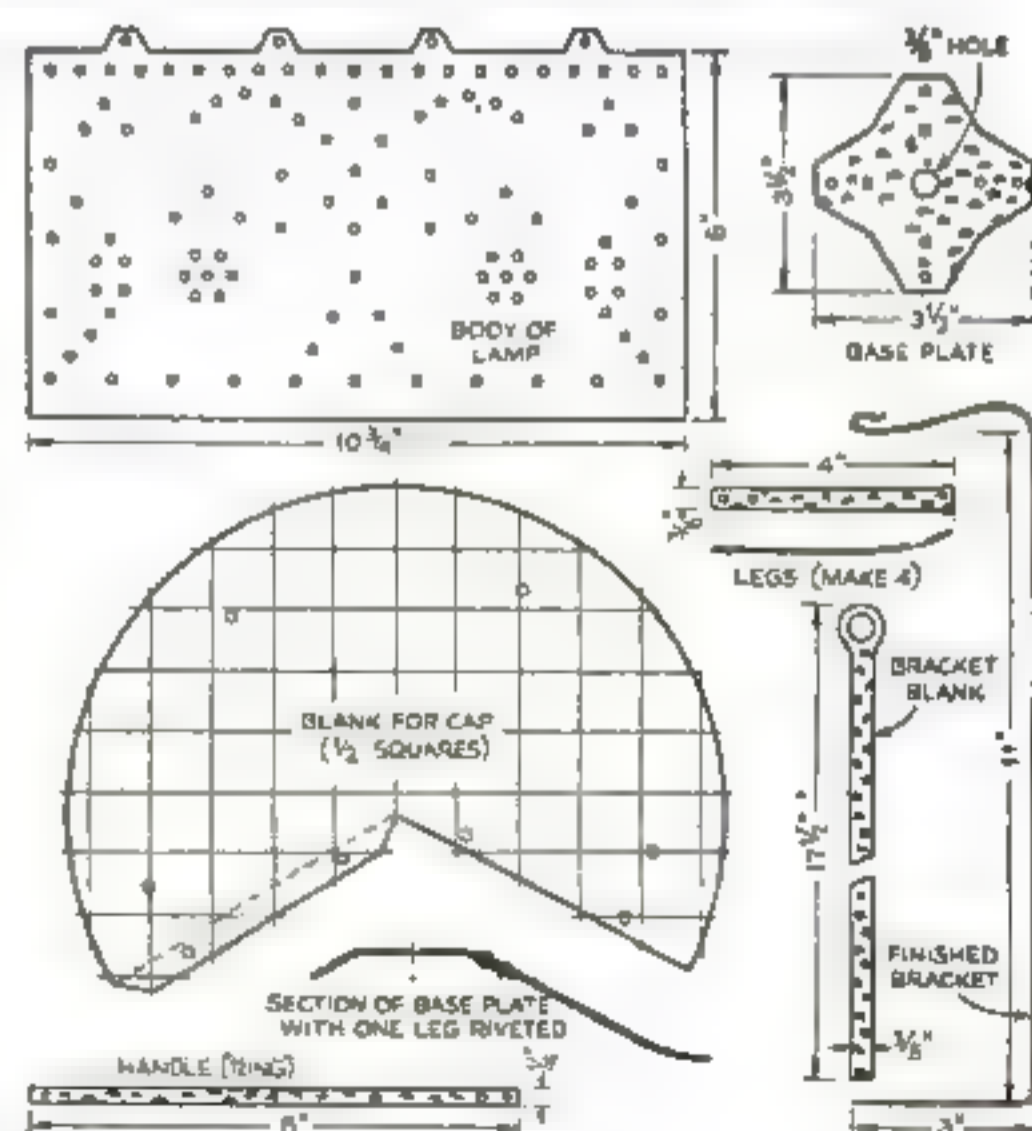
## HALL LAMP DESIGNED LIKE OLD-TIME LANTERN

THIS perforated copper lamp, which casts a soft light and makes an especially effective piece for hall illumination, can be easily made by following the diagrams at the right.

A sheet of 16-gauge soft copper is used for making the base plate, legs, and bracket. The pieces are hammered and bent into shape as shown, and then assembled with brass escutcheon pins. A pull-chain socket is attached to the center of the base plate in an upright position and wired with a drop cord and plug.

No hammering is necessary on the body and cap, which are made of 22-gauge copper. It is possible to work out any desired design in the lantern's body, the holes being either punched or drilled. The lantern cap is cut out as shown, rolled into a conical shape, and riveted. Escutcheon pins are used for attaching the cap to the body. The overhanging edge is then bent down as illustrated in the photograph.

The handle is made of 16-gauge copper, which is cut out, hammered, and rolled into a ring. A ⅛-in. machine bolt is used for attaching it to the cap. The lantern is left in its original finish.—DICK HUTCHINSON.



Body and cap are 22-gauge copper; the rest, 16-gauge

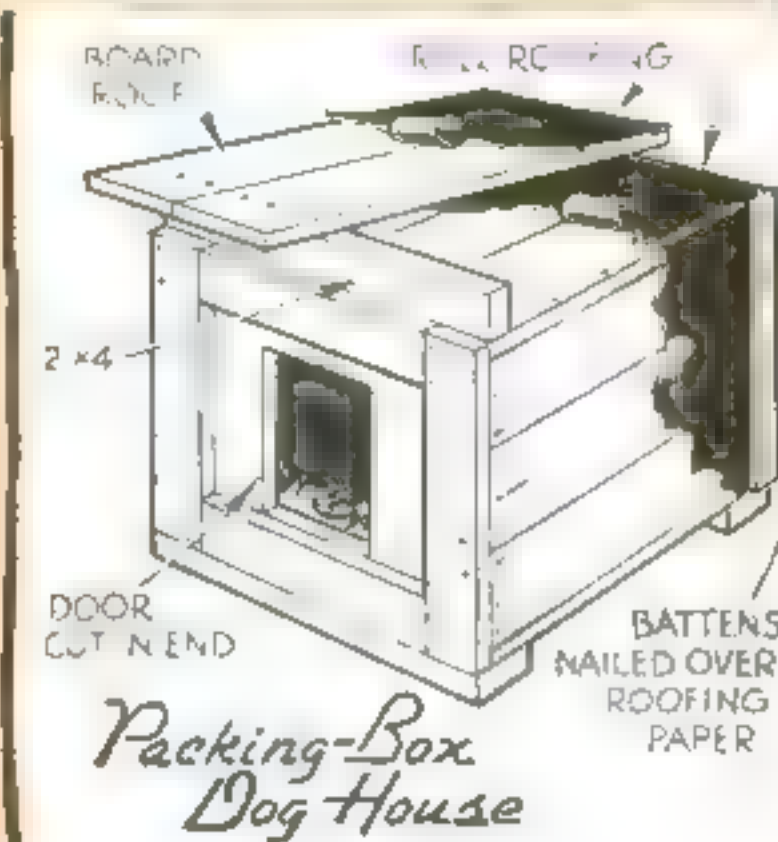
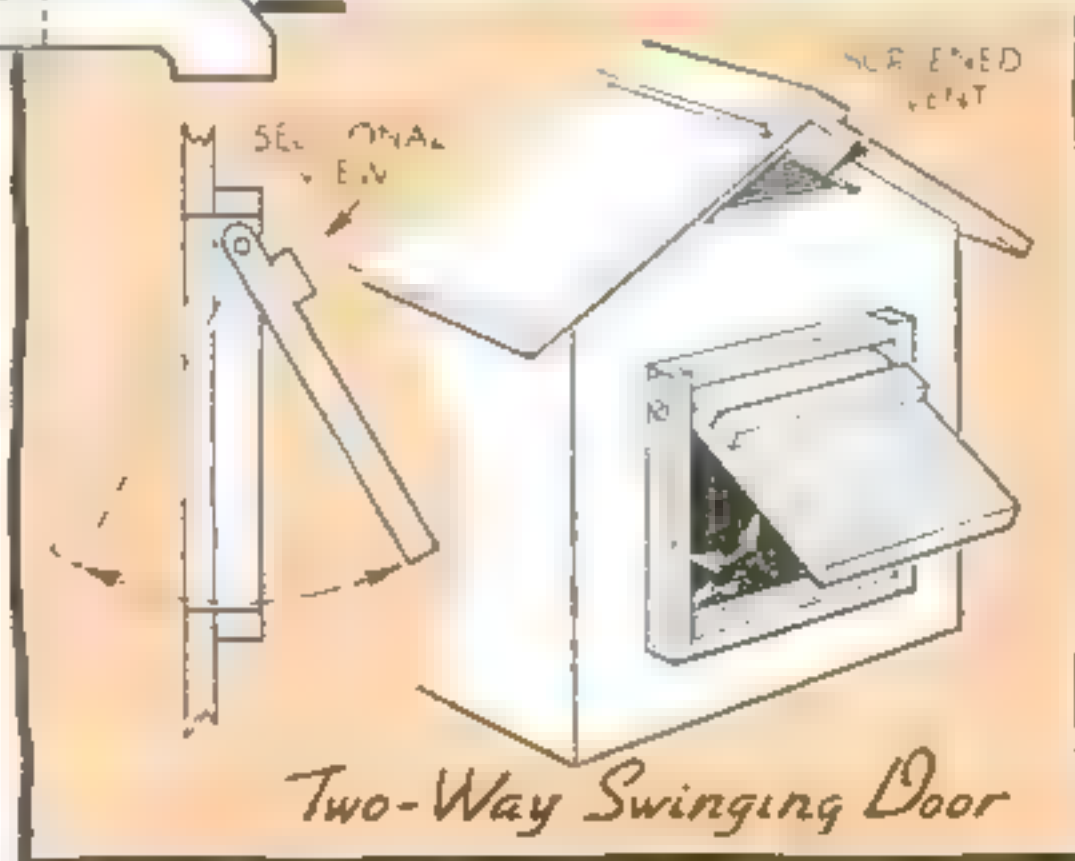
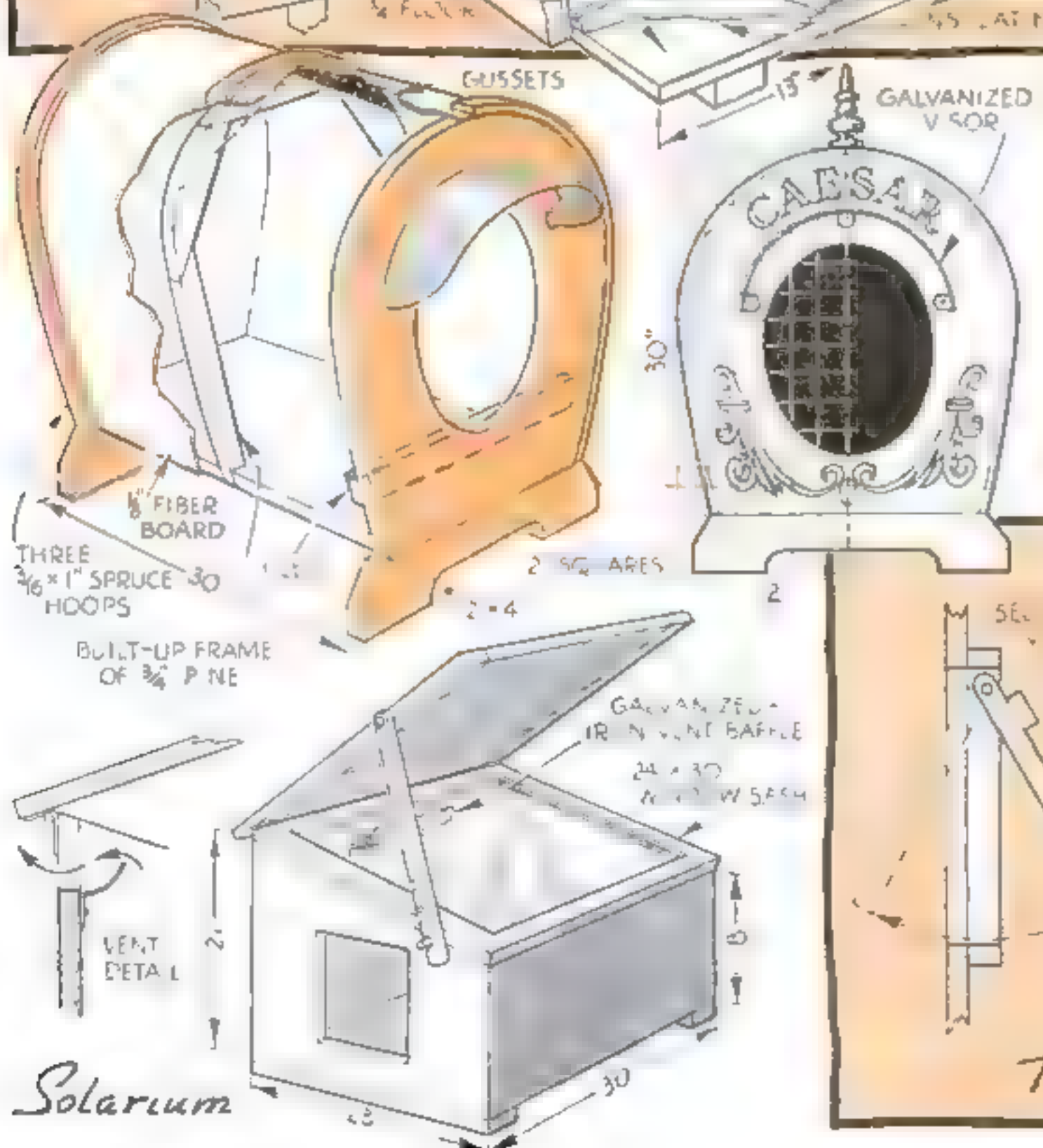
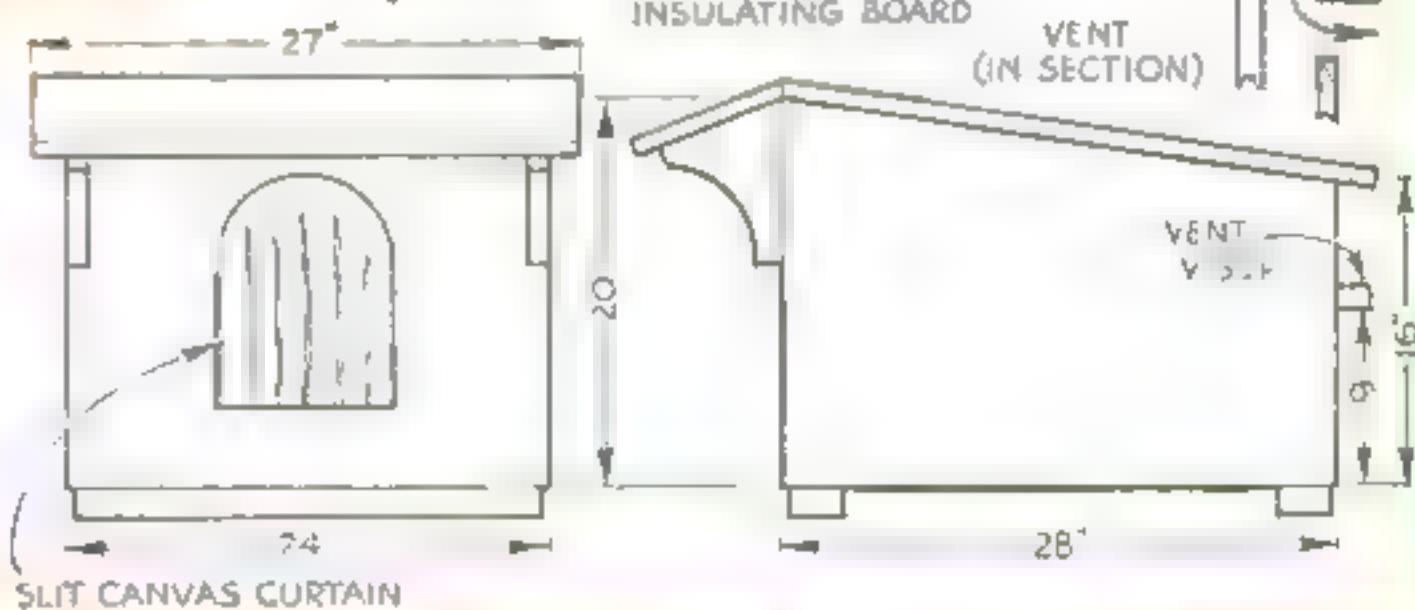
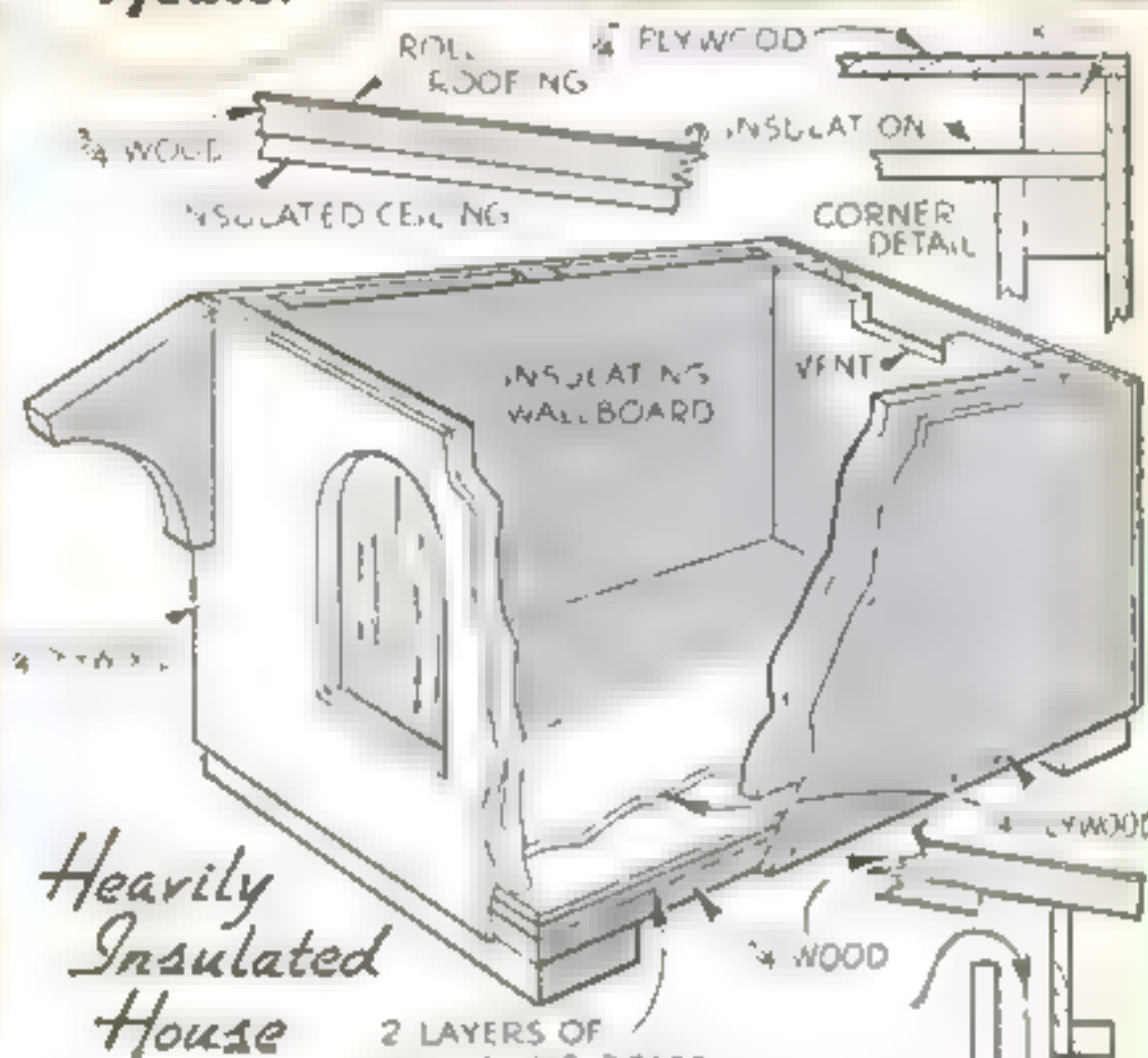
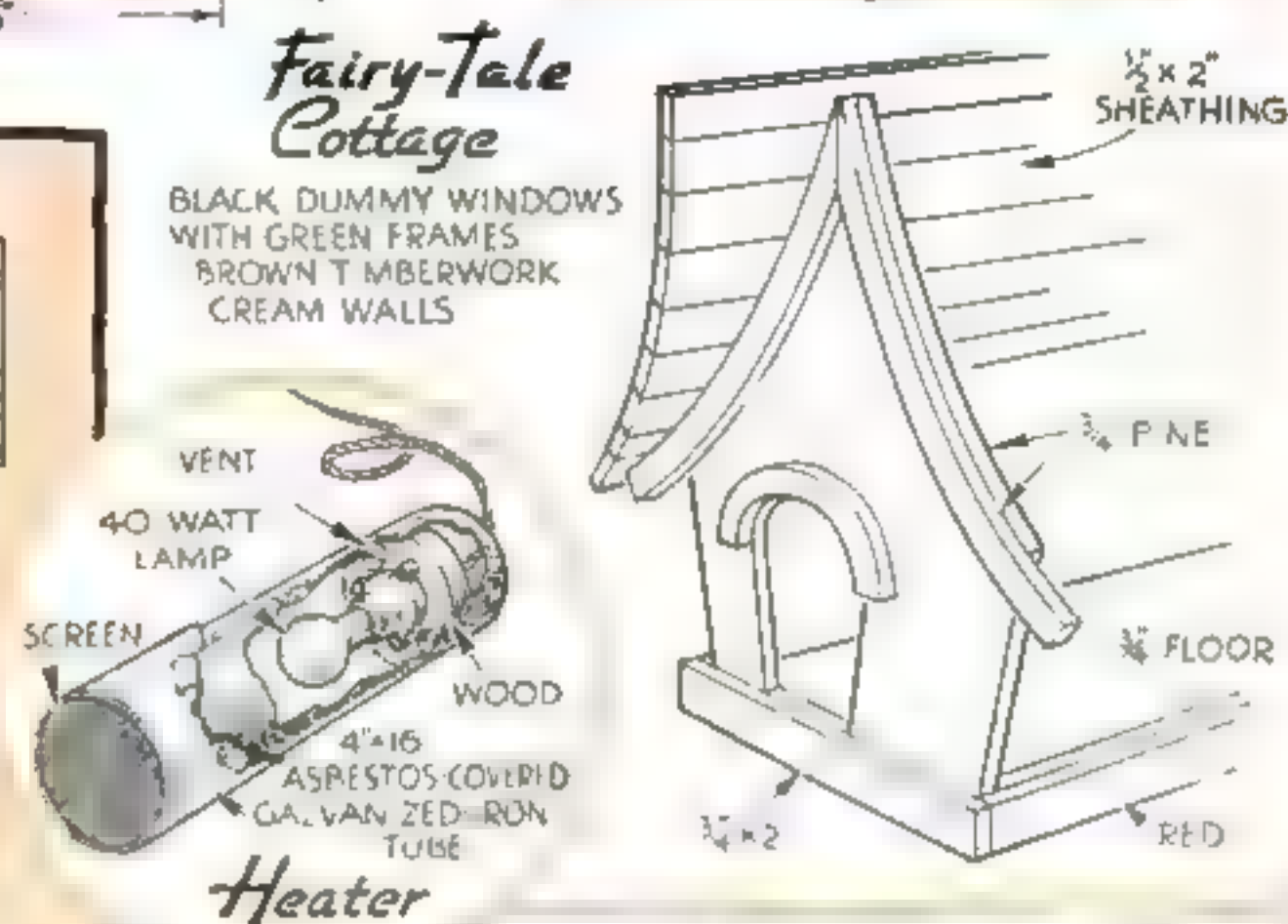
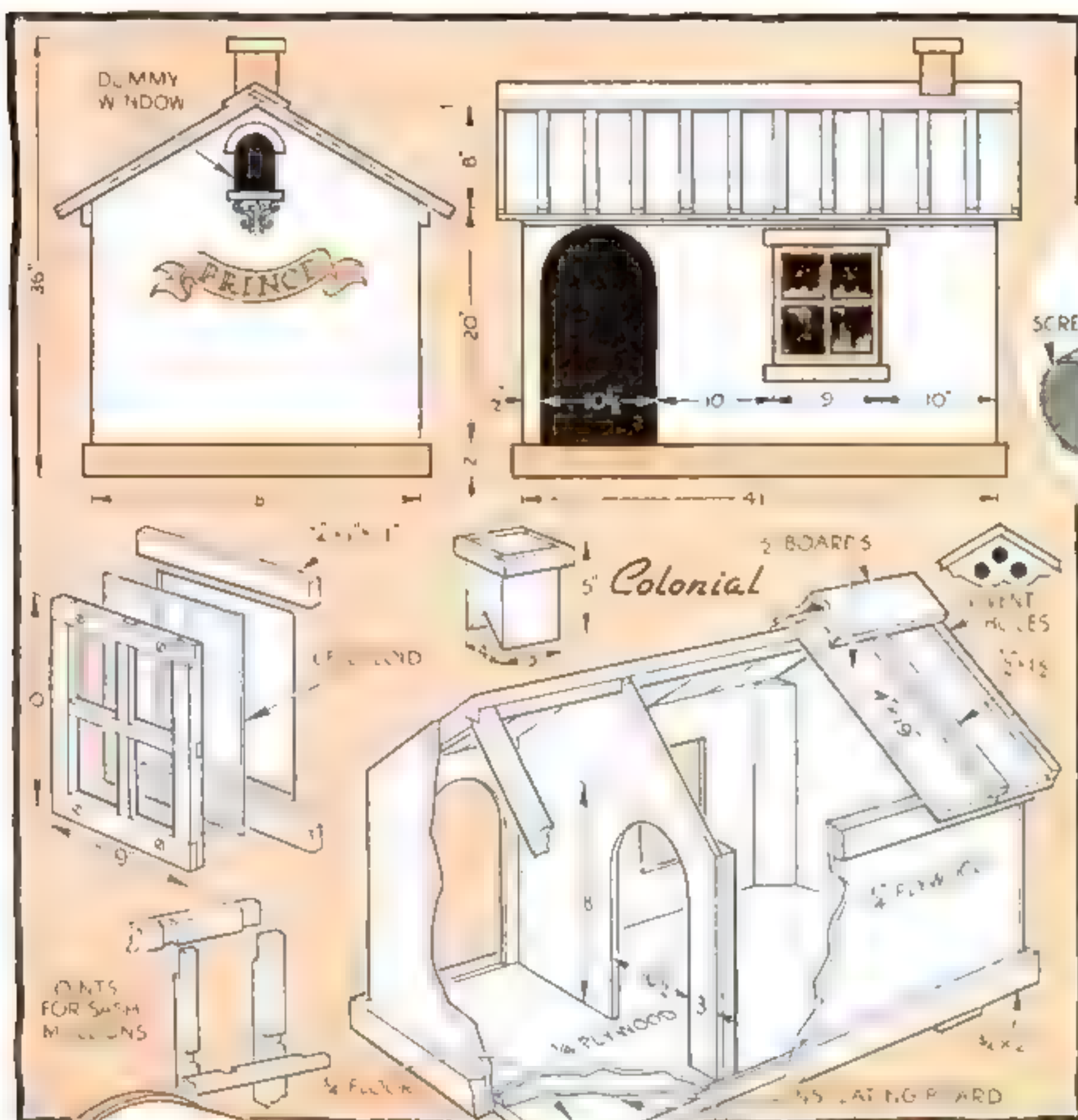
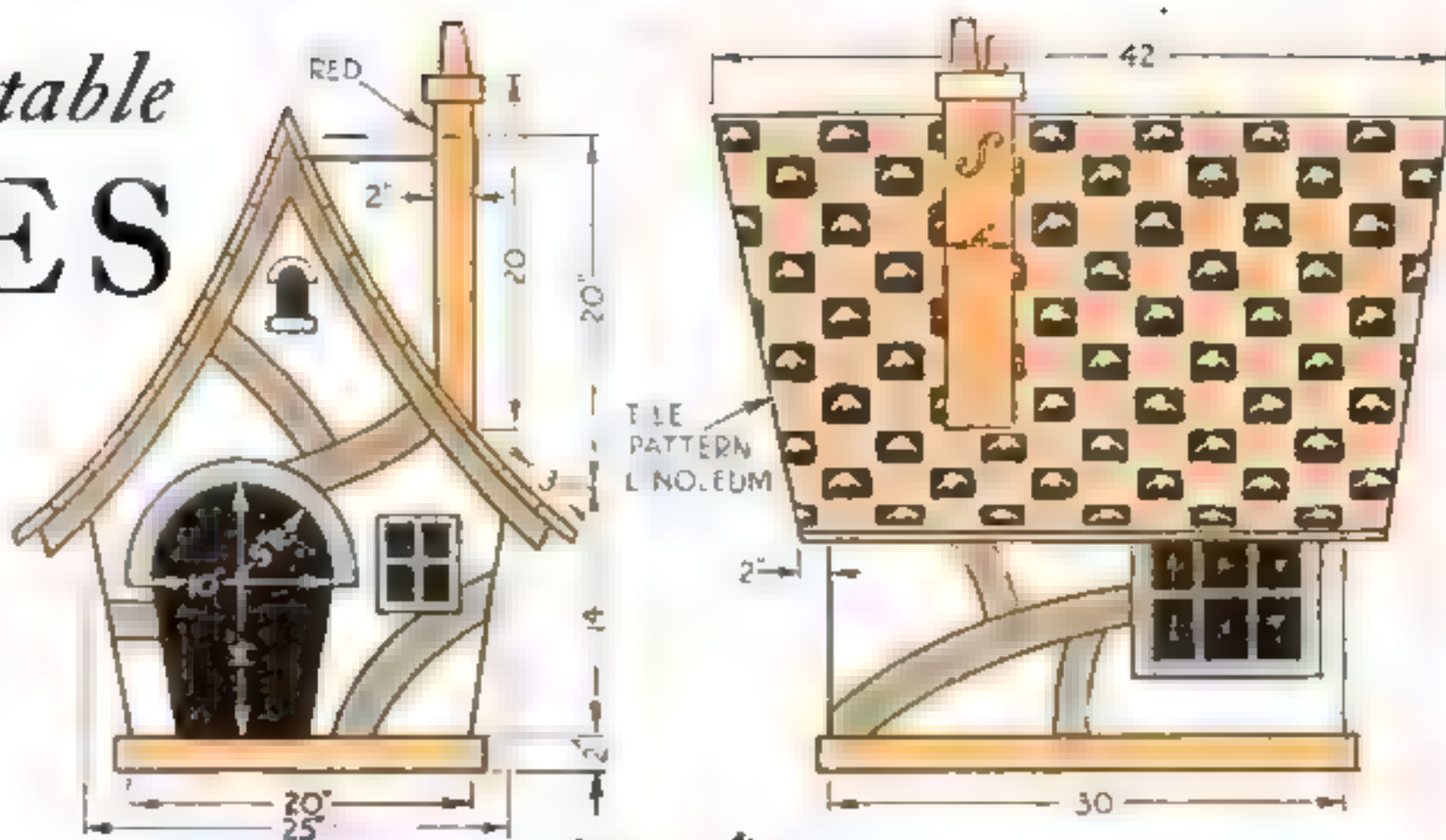


Light shines through the perforations and gives a subdued illumination suitable for halls

# Seven Ways to Build Comfortable DOG HOUSES

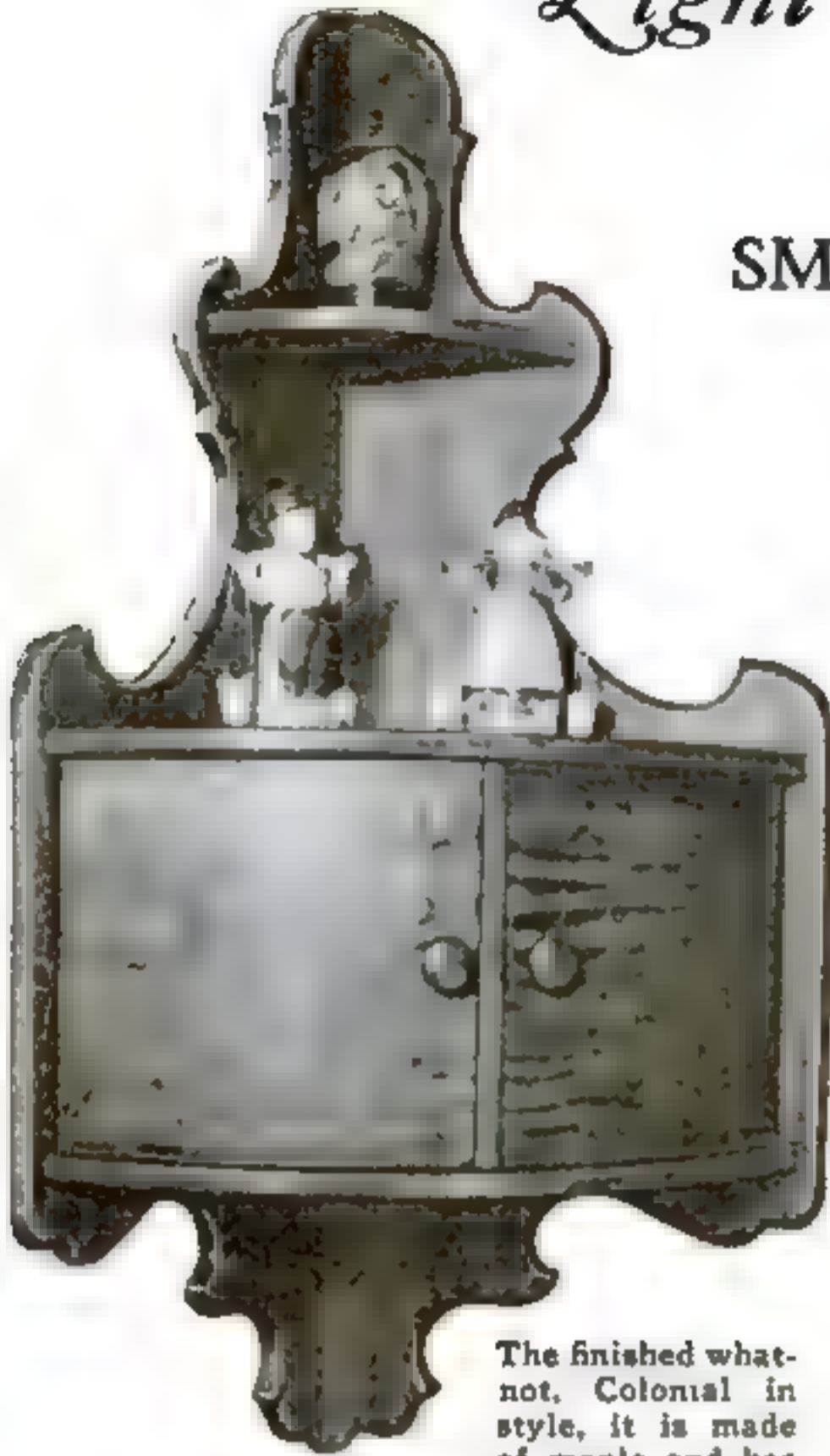
By H I SIBLEY

**D**OGS appreciate comfort so much that it gives genuine satisfaction to build good houses for them. The designs illustrated are suitable for a wide variety of conditions, and the dimensions can be adapted to the individual pet. Warmth, freedom from drafts, and cleanliness are important. For the house located out of doors, excelsior makes an excellent bed because it can be removed periodically and burned.

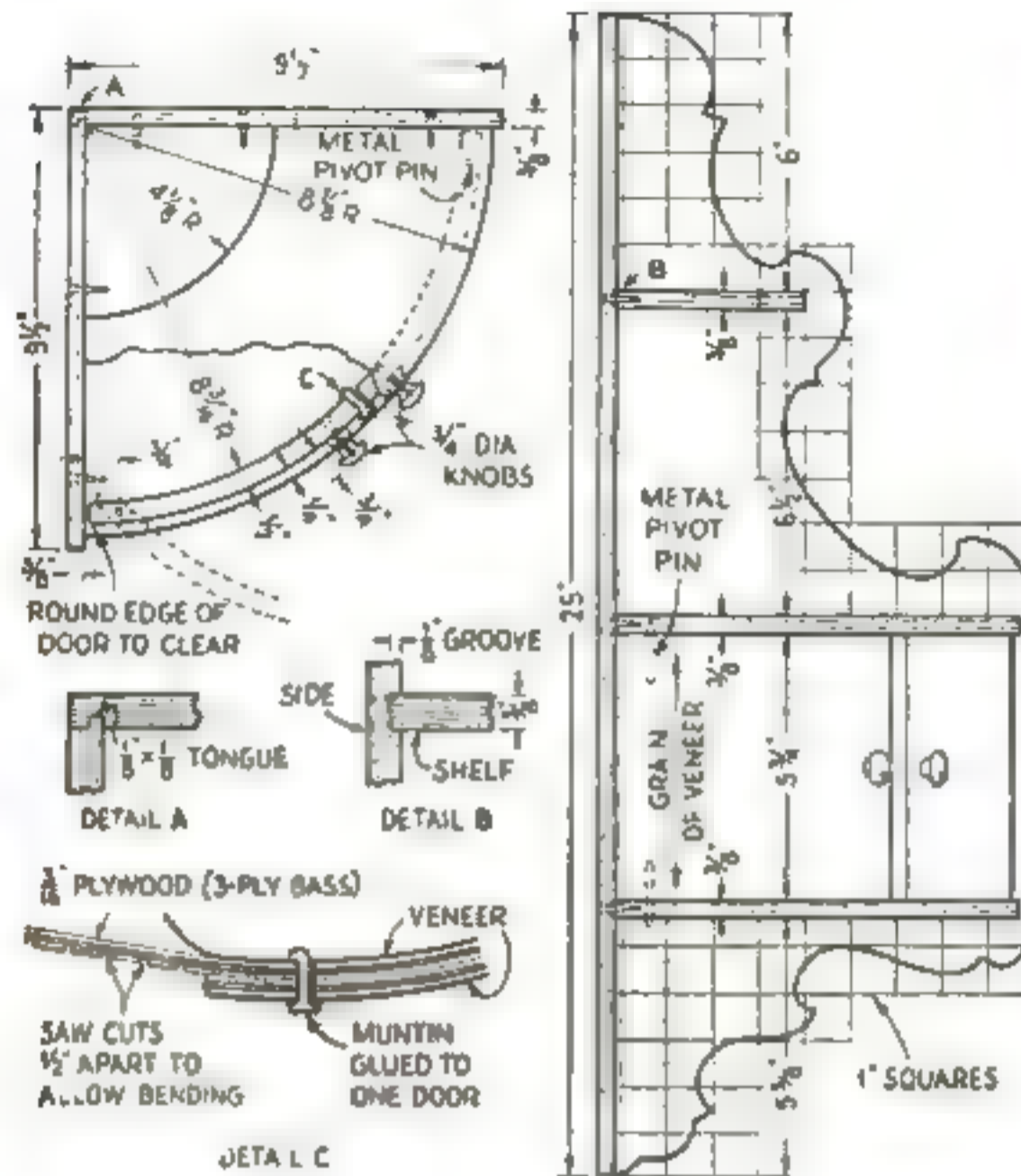


# Light CRAFTWORK

## SMALL CORNER CABINET HANGS ON WALL



The finished whatnot, Colonial in style, it is made of maple and has fiddle-back doors



The working drawings with squares for copying the curves



Cutting the door-gluing form with the upper band-saw guide reversed

**BY VIRTUE** of its quarter-round cupboard doors and deeply recessed upper shelf, this corner cabinet or whatnot possesses a distinctive character. Its upper shelves provide a show place for favorite figurines, and the cupboard conceals the extra can of tobacco, pack of cigarettes, ash trays, or decks of cards.

Any standard cabinet wood may be used. The piece illustrated was made of maple. Plain stock was used for the sides and shelves, but the doors were faced with veneer having a fiddle-back figure.

The making of the curved doors is the only unusual part of the job and should be done first. Then, if the curvature does not turn out exactly as planned, the rest of the design may

be adjusted to suit the doors as constructed.

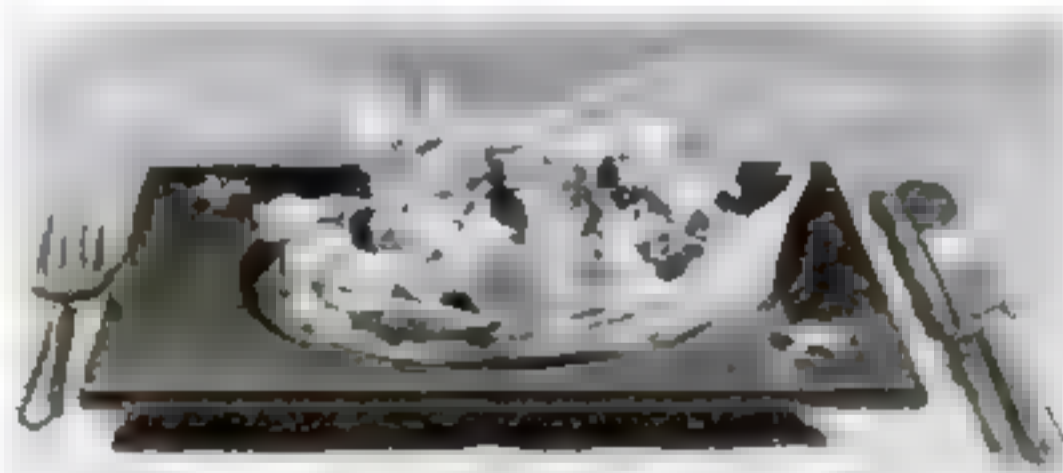
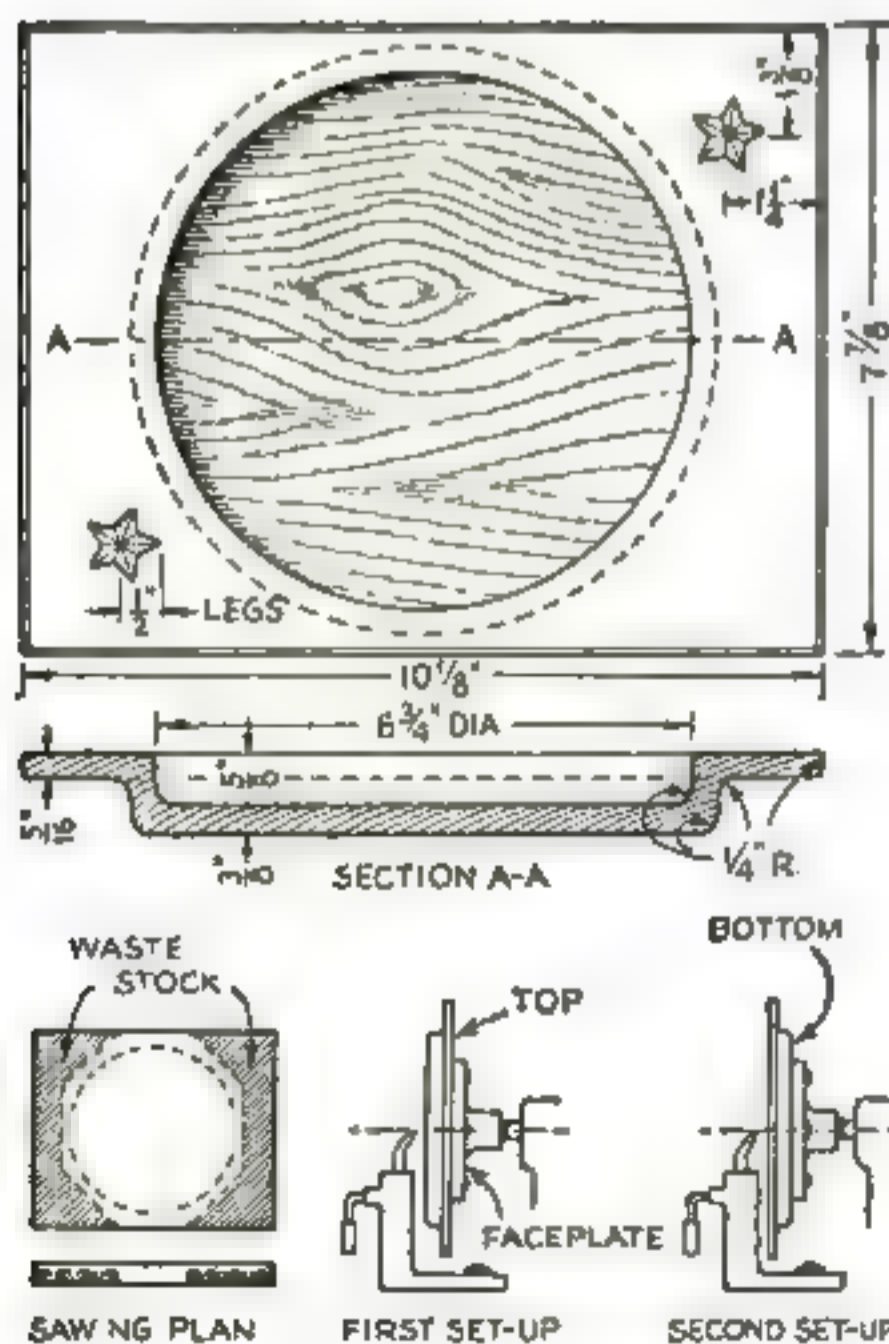
If the process to be described for building up the doors of bent plywood and veneer seems too much trouble, it may be side-stepped by band-sawing curved segments out of thick wood. However, the built-up method was decided upon in order to take advantage of the especially attractive grain patterns that are obtainable only in veneer form.

A clamping form for shaping the door was made from a block about 9 by 3 1/2 by 6 in., glued up of scrap wood and squared on four sides. On the band saw, a curved section was cut out of this block as thick as the finished door plus an allowance for gluing pads to be used on each side. For *(Continued on page 89)*



Plenty of clamps should be applied when gluing each door in the form

## DECORATIVE WOODEN SALAD PLATES TURNED ON THE LATHE



One of the salad plates and, at left, the dimensions and sketches showing three steps in the construction

**D**ANUBE blue border, maple grain recess, polished brass stars—all add to the rich appearance of the wooden salad plate shown above. Made up in a service of six, the plates will lend novelty to any dining table or buffet.

The maple stock is 1 by 8 by 10 1/4 in. Remove as much waste stock as possible by sawing. With wood screws fasten the rough plate in the lathe according to the diagram of the first set-up and turn off the corners. Card-board templates of the curved surfaces will help in turning uniform arcs. Sand the lathe-

worked surfaces while the piece is in the machine.

The bottom of the plate is 3/8 in. thick when finished, so in the second set-up use more wood screws to secure the work to the faceplate, placing them evenly and driving them in but a short way. Take small cuts to insure a good turning job. As in tooling the bottom, use a template for the curves, and sand the recess smooth.

Remove the work from the lathe, glue maple pegs in the screw holes, and when the glue is hard, finish flush by sanding. Give the edges of the plate a 1/4-in. radius, and sand to the finished size.

Wax or oil the recess, or give it two coats of varnish and one of wax. Two coats of Danube blue enamel on the top surface and over the entire bottom complete the coloring. Keep the surfaces free of dust and smooth during the varnishing and enameling. Brass stars or other emblems such as maple leaves or clover leaves may be bought from workshop specialty dealers.—D. W. P.

# NOVELTIES

GIVE CHANCE  
TO TRY NEW METHODS

## Veneering and Cabinetwork

COLONIAL CORNER WHATNOT

## Wood Turning

SALAD PLATES... BUILT-UP  
LAMP AND CIGARETTE BOX

## Jig Sawing and Carving

"GRANDFATHER'S BARN"  
NECKTIE RACK AND MAORI  
DINNER BELL (See page 88)

## UTILIZING SCRAPS OF WOOD

TWO unique wood-turning projects, a cigarette box and a novelty lamp, may be made as shown from scrap lumber, a piece of metal tubing, and electric lamp fittings.

The base, cap, and knob for the cigarette box are turned from three pieces of walnut, and hard-drawn copper or brass tubing forms the body. First turn the inside of the cap on a screw center, making the cut shown at A-A. Turn the base next, making the inside cut B-B a tight fit for the tubing, which in this case has an inside diameter of 2 in. and is 2 5/8 in. long.

After the profile of the base is completed, assemble the box in the lathe with the base on the faceplate, the cap at dead center, and the tubing between them. Finish turning the cap, sand the wood parts smooth, and polish the metal with fine steel wool, sandpaper, or emery cloth. The bands are cut with the broken end of a file, and the initial or monogram with a small V-shaped carving tool. Lacquer the box or give it a French polish. If shellac and oil are used, do not apply too heavily on the metal. The knob is turned last and fastened to the cap.



FIRST STEP IN BUILDING UP BLOCK

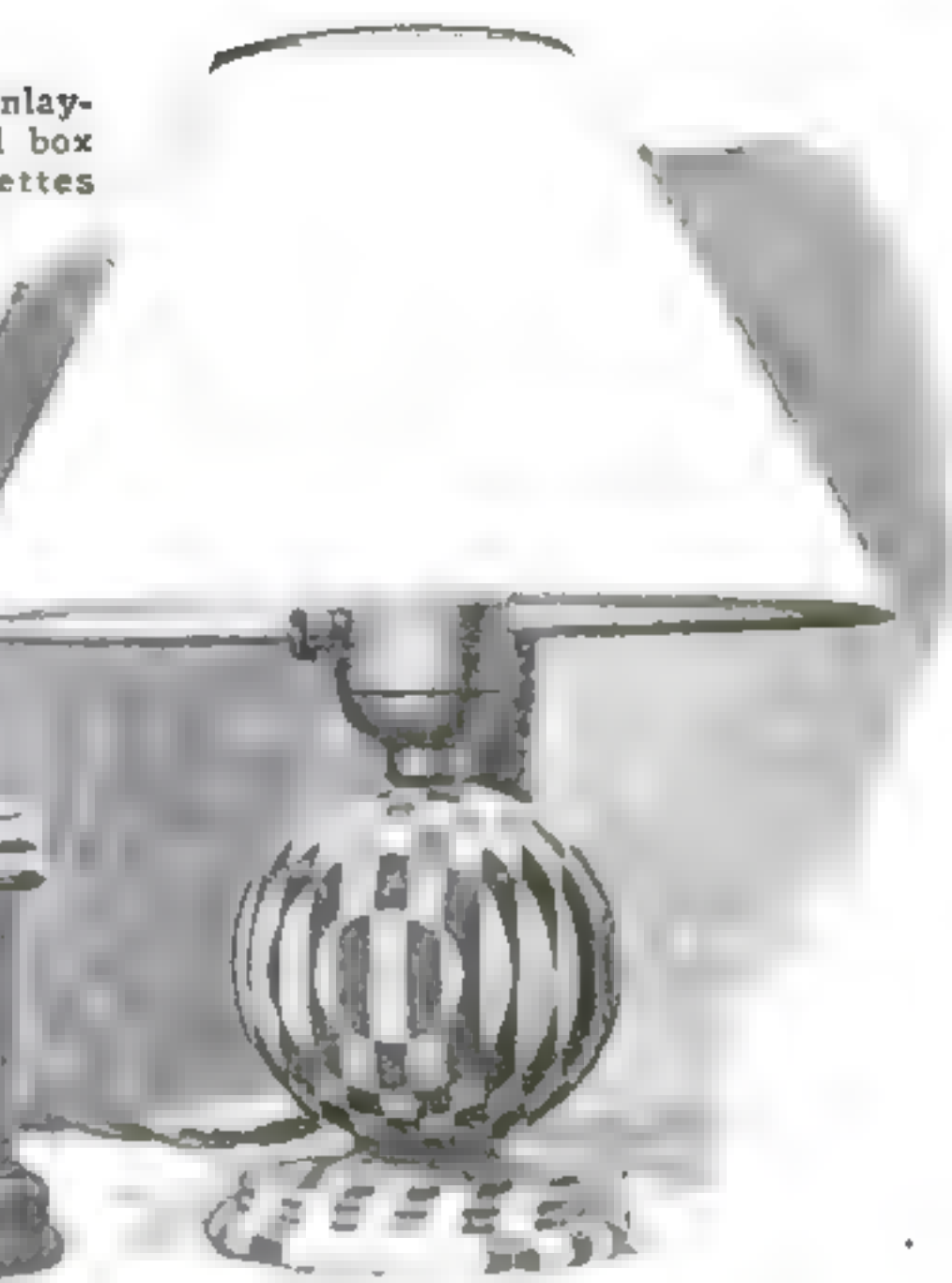
How the stock for the lamp is glued up and sectional drawings of both the cigarette box and the lamp, as assembled



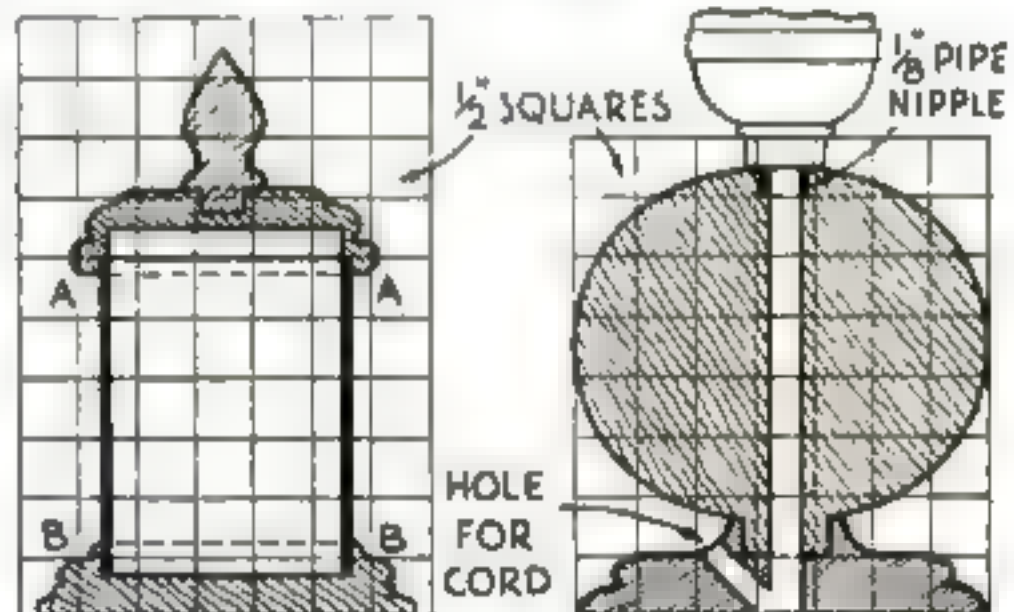
BLOCK READY TO TURN

For the lamp, two woods of contrasting colors such as white holly and black walnut are used. Rip and dress seven pieces of each to 1/4 by 3/4 by 33 in. and glue to form a piece 3/4 by 3 1/2 by 33 in., alternating the colors. Use a stain-free glue.

After the glue has hardened thoroughly, rip on line A and dress the two halves to



Lamp made by the "inlay-turning" method, and box for holding cigarettes



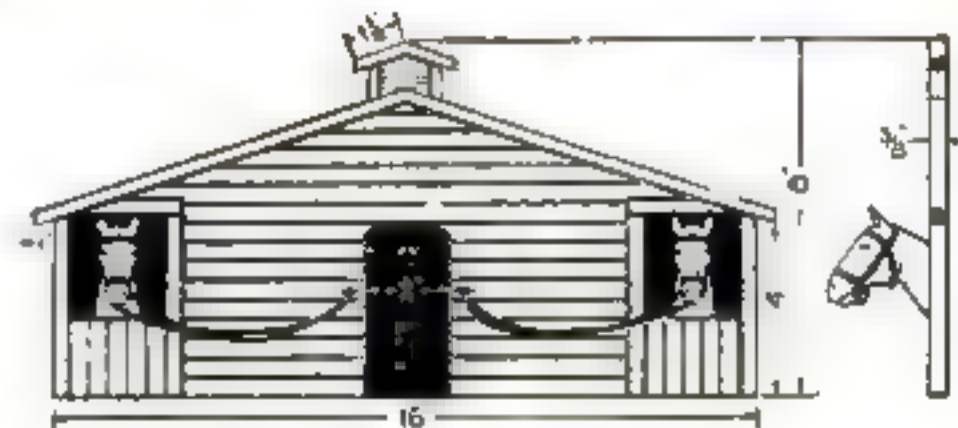
1/4-in. thickness. Cut off fourteen pieces 3 1/2 in. long and glue these to form a 3 1/2-in. cube, again alternating the colors to give a checkered effect. Then cut three pieces 3 1/2 in. long and glue together for the base, the grain of the middle piece being at right angles to the top and bottom pieces. —NEIL NELSON.

## MINIATURE STABLE HOLDS NECKTIES

GRANDFATHER'S barn, where the horses used to stand with their heads out looking over the green hills, suggested the design of this novel tie rack.

The barn is drawn on 3/8-in. thick wood or thinner plywood or composition board and cut out on the jig saw. The doors are laid out and also the lines for the siding. These can be painted on, but look more realistic if cut into the surface. The quickest way to do this is to use a fluting cutter in a flexible shaft, if available. Collars should be used with the cutter so that only a shallow cut is made.

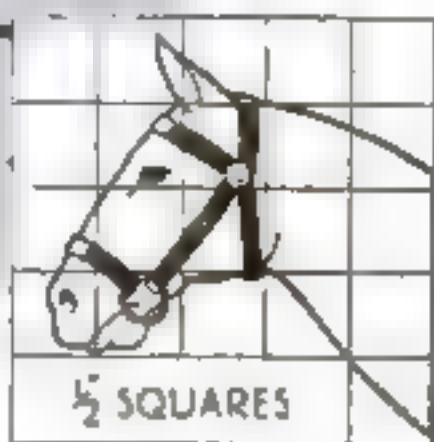
The heads of the horses are drawn on 1-in. thick wood and jig-sawed to shape. If one is careful, the corners can be rounded at the same time by tilting the blocks and taking light cuts. They are finished by using the flexible shaft or with the aid of a short dowel covered with sandpaper and rotated at high speed in the drill press. Of course, all the work can be done easily by hand. (Continued on page 89)



A photograph of the tie rack as it hangs on the wall and a drawing with the over-all dimensions. The reins, over which the ties are hung, are calfskin lacing 1/4 in. in width



When jig-sawed, the heads of the horses may be carved and sanded in next to no time if a flexible shaft is available



# GRACEFUL Coffee Table

## OF WROUGHT IRON AND WOOD

By H. T. Shrum

METAL-WORK INSTRUCTOR, STATE  
TEACHERS COLLEGE, OSHKOSH, WISC.

**T**O CONSTRUCT this coffee table of wrought iron and wood is not at all difficult even in a home workshop where tools and equipment may be quite limited. The band-iron legs are readily shaped to the plotted curves and either riveted, welded, or brazed together before being fastened to the top and shelf with roundheaded screws.

Black walnut, birch, or other 1-in. thick stock can be glued up for the top and shelf, and when dry, surfaced to  $\frac{3}{4}$  in. or slightly less. The wood is then band- or scroll-sawed to form disks of the required size. In the case of the table illustrated, an old square piano top served to make the top and shelf. Since the core was of softwood, the edges were finished with the same enamel used on the legs.

After the edges have been sanded true and smooth, they may be shaped, or in the absence of a shaper, they may be chamfered top and bottom to break the se-



A  
NATIONAL  
HOMEWORKSHOP  
GUILD  
FEATURE

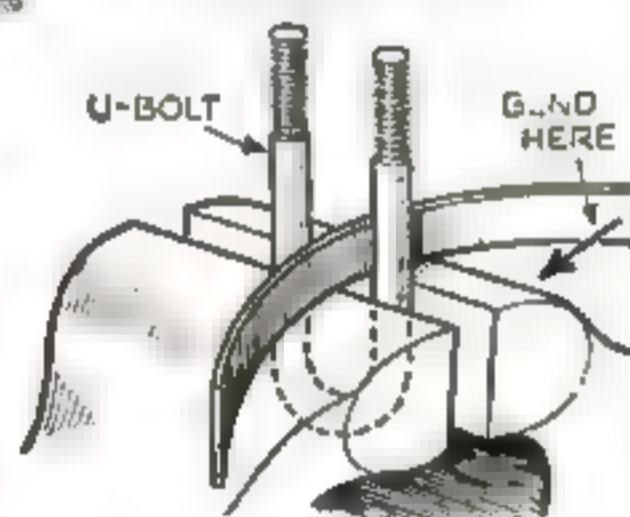
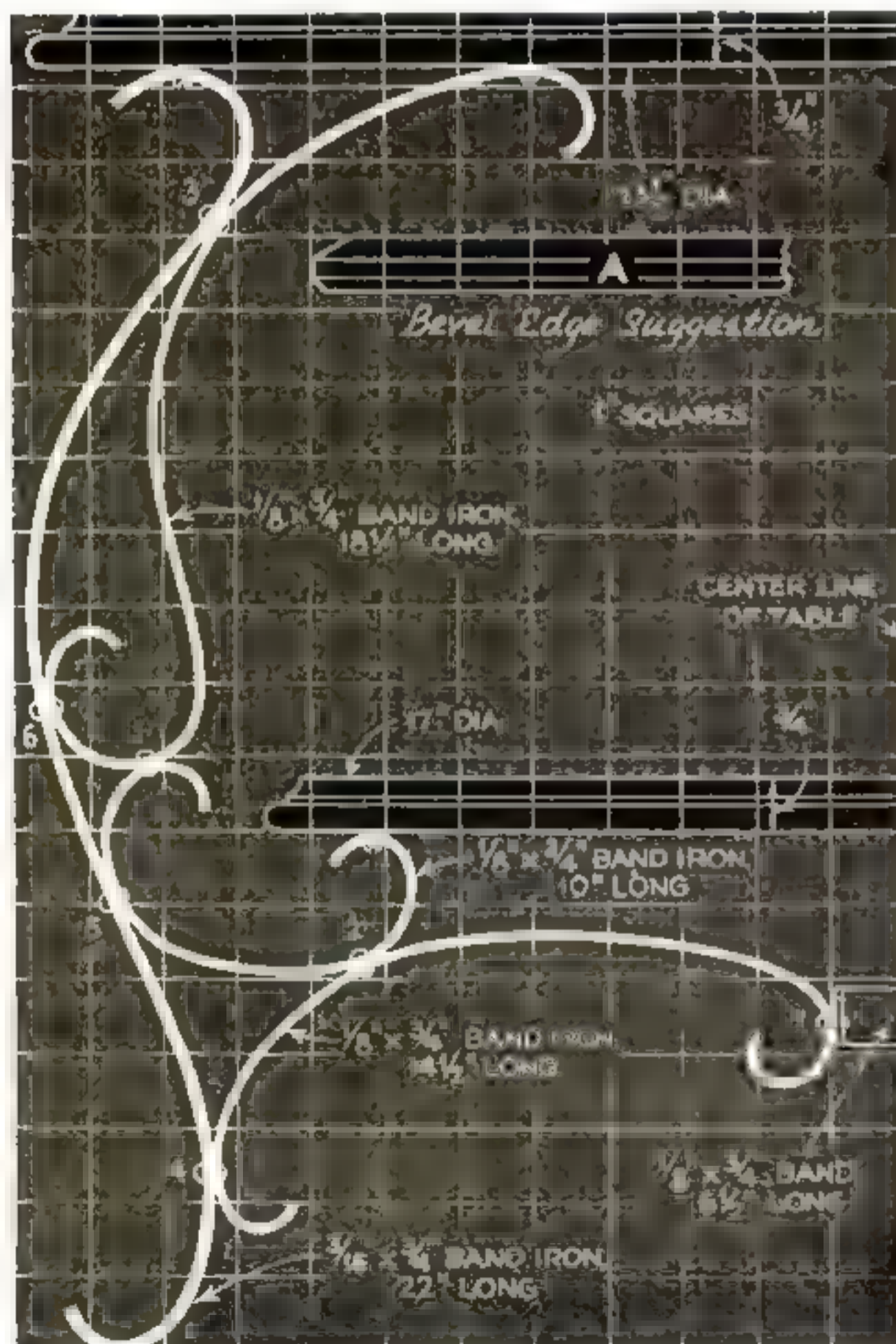


This unique coffee table, a pleasing addition to any home, can be easily constructed in the average workshop even if equipment is limited

verity of the sharp corners as shown in the sketch at A. Carefully scrape and sand the finished parts and apply stain, filler, and varnish coats to bring out the full beauty of the wood.

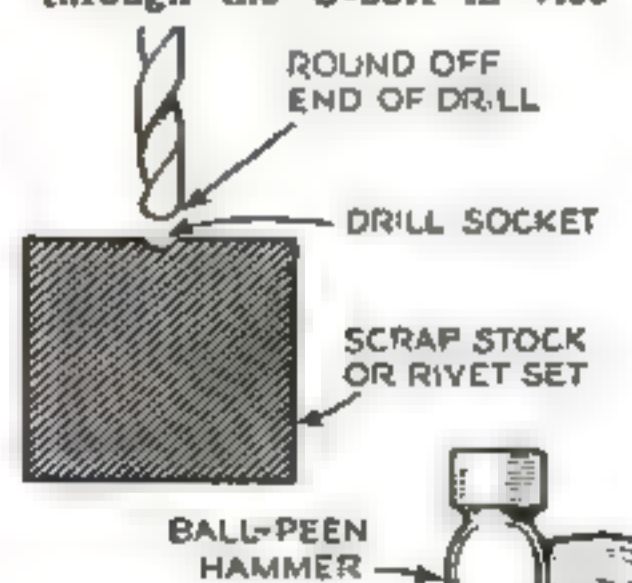
There will be numerous intervals while working on the top and shelf when one's attention may be turned to the leg construction. A full-size sketch should be made of the leg curves as a guide for shaping them and fitting the parts together. This lay-out may be made on paper or on the bench top with chalk since no heat is used in shaping. Note that the main stem of the leg is thicker than the other parts.

The shaping of each piece is accomplished by a series of slight bends following close upon each other as the stock is advanced between the ends of a U-bolt held as shown in a vise. Care must be taken to make the bends close together and square across the stock. If they are too far apart, the curves will appear bumpy or flat in spots. If the parts do not lie flat after shaping, they are best straightened by gripping the sides in a vise and bending. (*Continued on page 87*)



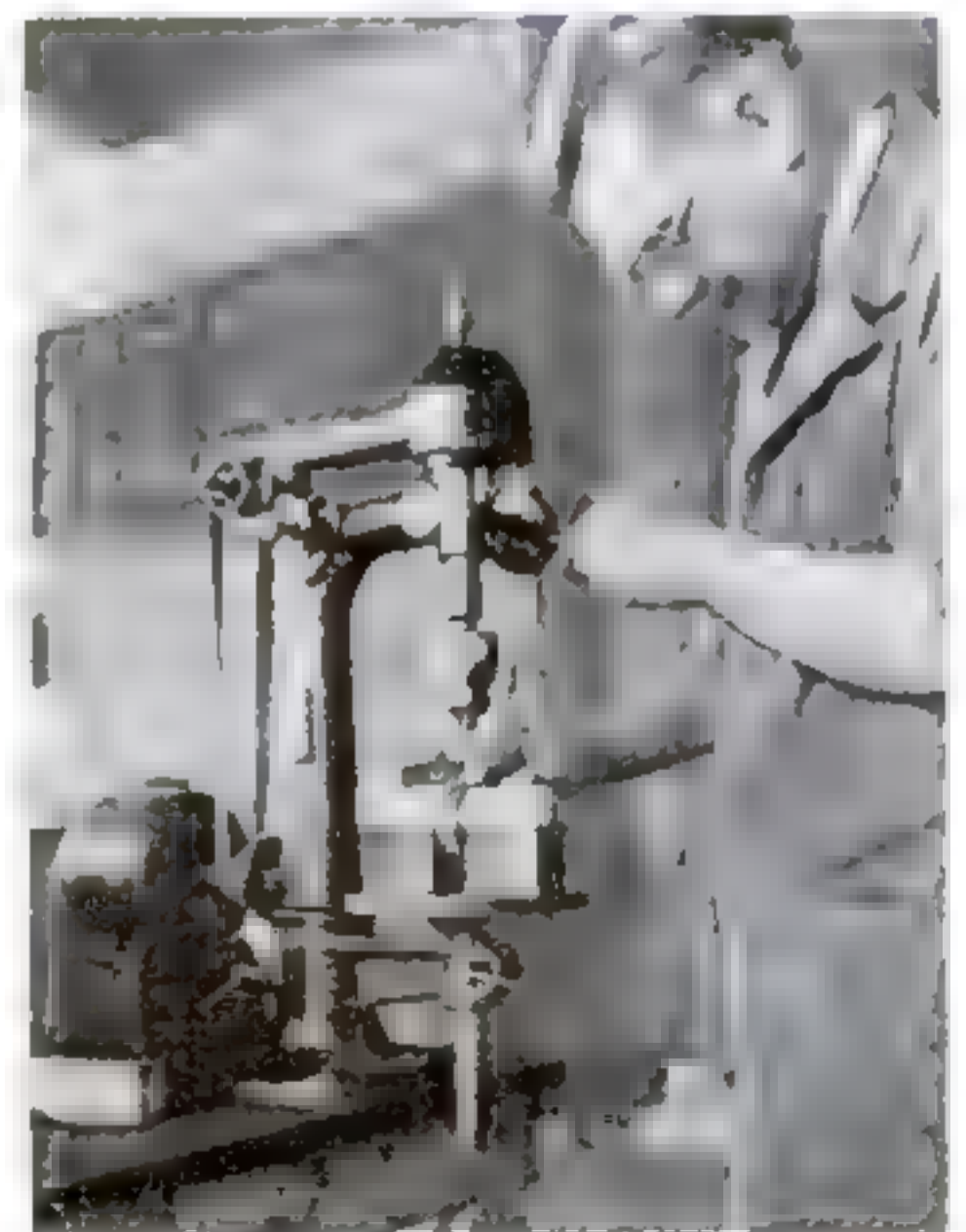
Method of Shaping  
Band Iron in Vise

Each wrought-iron band is shaped through a series of slight bends as it is drawn through the U-bolt in vise.



Showing How  
No. 6 Joint  
is Riveted

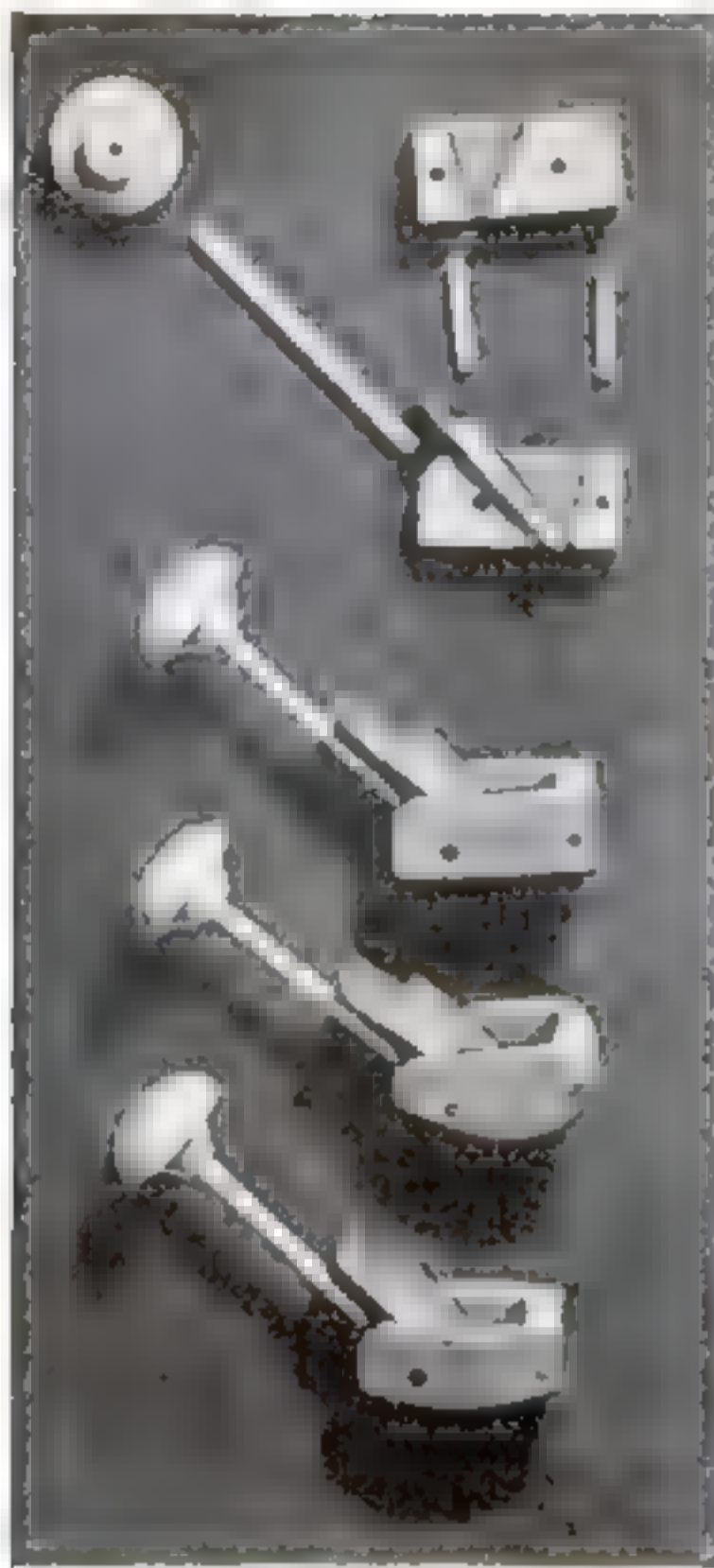
The bands of iron must be carefully center punched, drilled, and then riveted as illustrated above. The author, at right, is shown drilling the rivet holes. At the left is the pattern



# Tiny Thumb Planes

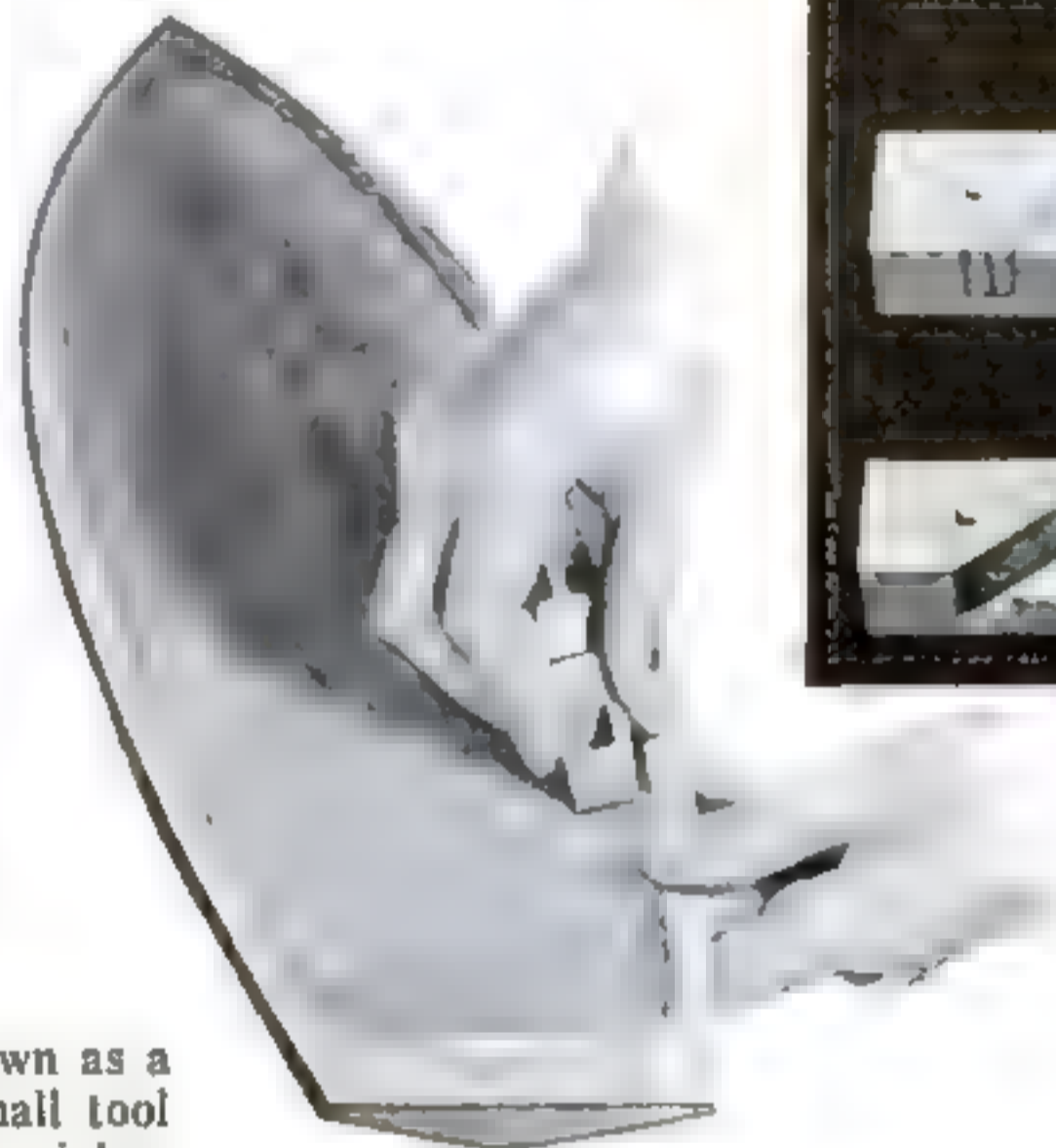
## AID IN BUILDING MODELS

*You can make a whole set for a few cents and will find them invaluable for shaping hulls and similar work*



The parts of a thumb plane ready for assembly, and three complete planes with bottoms of different shapes. The body of each plane is made in halves, then doweled

The inside of each block is marked as shown at the right, then slotted with a saw and finished with chisel and file. A round-bottom plane is illustrated below in use on the inner curves of a model sailboat hull



sides can be finished, and then the bottom of the plane can be shaped as you desire—straight, concave, convex, or in any other form.

A palm rest turned to the shape and size shown in the drawing is to be preferred; however, a serviceable rest may be made from a slice of  $\frac{3}{8}$ -in. dowel with the top rounded, and a hole drilled in the bottom to take a  $\frac{1}{8}$ - or  $\frac{3}{16}$ -in. dowel. The wedge is made of hardwood as indicated.

The blade is a piece of hack saw or similar steel, ground and honed to the shape of the bottom of the plane. In setting the plane, let the blade project just a hair from the bottom.

Although the utility of these little tools is more or less obvious, a few of the many jobs may well be mentioned where they will be found to do better work in less time. The flat plane can be used to shape decks, deck houses, and other small parts necessary in making models. The convex or full round is most helpful in shaping the flare at the bow of ship models, also for shaping the inside of ship and sailing models. The concave plane has been found just the tool for shaping masts and yards; it does the work neatly and makes it much easier.

By **GEORGE W. NIEDERMAIR**

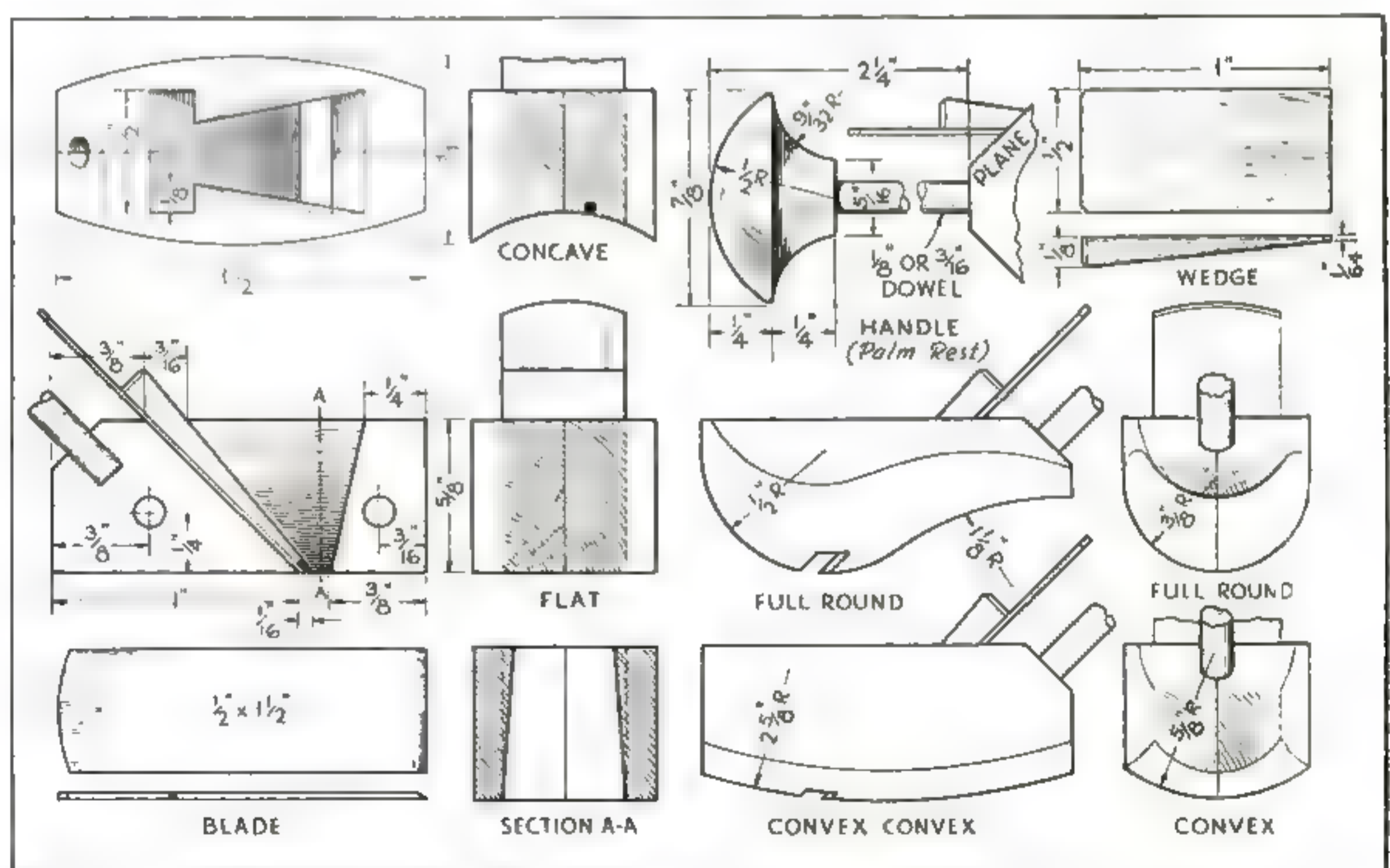
**W**HAT is familiarly known as a "thumb plane" is a small tool invaluable in making violins and similar musical instruments and in shaping model ships, airplanes, sailing yachts, and the like.

The body of this plane is held between the thumb and forefinger, and the handle butts against the palm of the hand. With the ordinary plane of this type, the fingers get tired very quickly, but with the new design illustrated, it is possible to work for several hours without undue fatigue or cramps in the fingers because a good deal of the thrust required to push the plane is taken up by the carefully designed palm rest.

The body of the plane is made of two pieces of maple, beech, or some other hardwood with a fine, close grain. Each piece should be  $\frac{3}{8}$  by  $\frac{5}{8}$  by  $1\frac{1}{2}$  in. Clamp them together and drill two  $\frac{1}{8}$ -in. dowel holes as shown in the drawing. With the dowels in place, mark the top and bottom of the pieces; then remove the dowels and mark the inside of both pieces. With a small

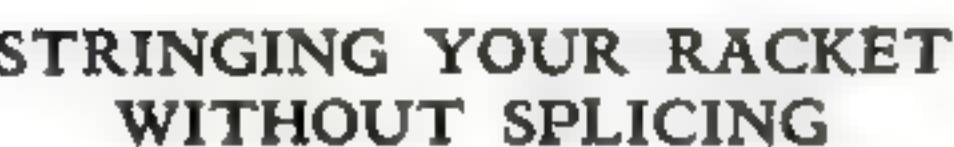
saw, chisel, and file, remove the waste wood.

When you have finished shaping the inside, the two parts should be doweled and glued together. After the glue has set, the



Full-size drawings of thumb planes to show the method of construction and various shapes found useful for models

中国书画函授大学肇庆分校



Thread the 21-ft. string and pull to one side of the frame, placing the short end under the loops as usual (Fig. 1). Hold the remainder with a stringer's awl. Place the 12-ft. string under the other loops (Fig. 2) and tighten the main string in the regular manner. Thread the remainder up to the next hole and use it for the cross string down to the racket throat (Fig. 3). Then string the 12-ft. length to the head (Fig. 4).—DAVIS HUMPHREY.

WINDOW-SHADE brackets, designed to give better ventilation, can be made in either of the styles shown below. The first method is to prepare long, offset brackets and fasten them to the frame of the upper sash. When the sash is lowered,



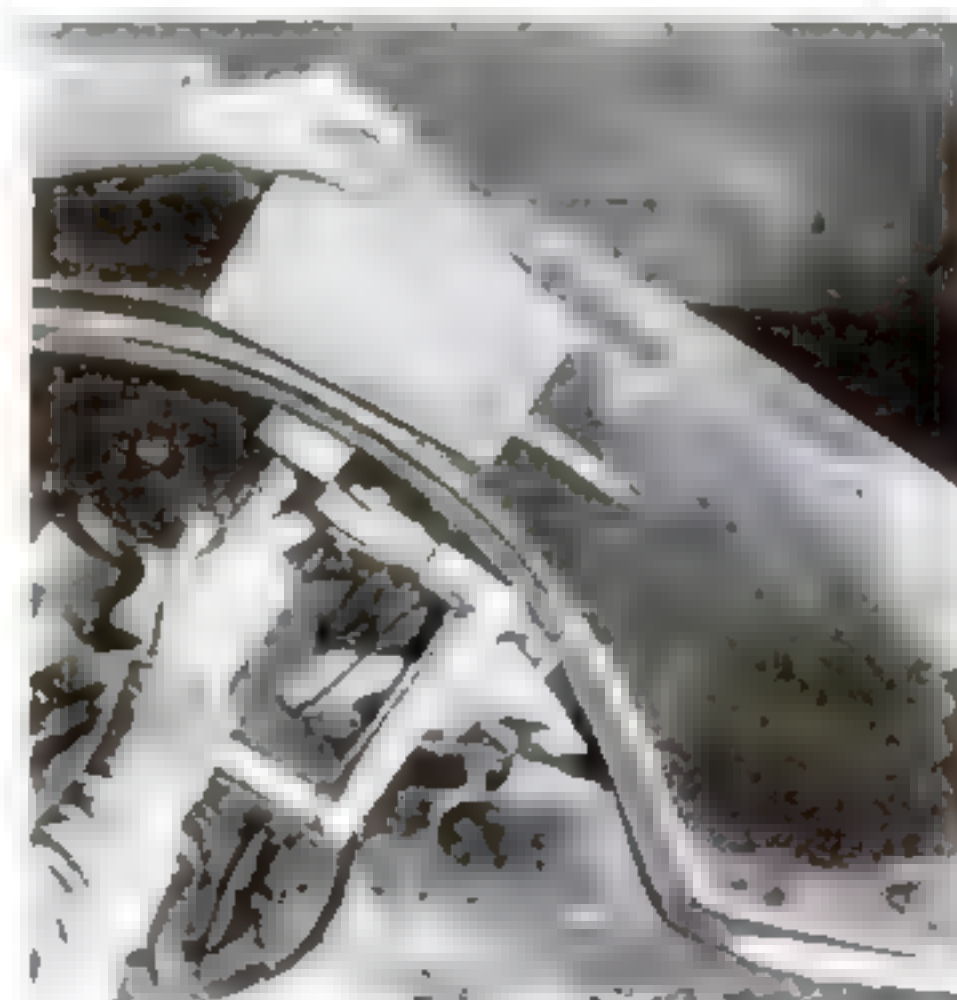
Roundhead stove bolts are used for fastening the parts together. Fourteen of these are required  $2\frac{1}{2}$  by  $\frac{1}{4}$  in., and two  $3\frac{1}{2}$  by  $\frac{1}{4}$  in. A  $\frac{1}{4}$ -in. metal drill is used to make the holes with, and care must be used not to split the poles. All end holes are drilled 3 in. from the end. The bolts are drawn up snugly but not so tightly as to crack the poles. Twisted wires brace



In the second method, a ridge on the washer of the adjustable bracket engages grooves on the guide mounted on each side of the frame.—**LAWRENCE N. OLSEN.**



Sisal binder twine is rather fuzzy and bristly, and when the weaving is completed it must be singed off with a blowtorch. This leaves a smooth, even finish to the hand-woven material of seat and back.—HAROLD JACKSON.



A PIECE of old hacksaw blade placed over the dent in an automobile fender, before applying a fender roller, will help distribute the pressure over the proper area and aid in preserving the paint. The roller illustrated above is a shopmade one. Old auto bearings are so mounted in the tubing that each moves in its socket when the set screw is loosened. As shown in the photograph, the rollers can be set for rolling the bead on a fender.—J. C. C.

# Homemade Weather Guide

SMILES IN SUNSHINE,  
FROWNS IN STORM

By  
Edwin M.  
Love



A small box filled with salt is mounted behind the disk that represents the sun. The salt becomes heavier with moisture in wet weather and causes the disk to revolve, thus bringing the frown into view.

**T**HIS impish cardboard sun, rising from a bank of clouds, smiles during sunny weather and frowns when rain is falling. As a matter of fact, he sometimes becomes gloomy several hours before the storm, thus warning the household of the impending downpour. He can be built in one evening from cardboard and other odds and ends costing not more than five cents.

Prepare paper patterns of the sun, which is 4 in. in diameter, and of the two clouds by sketching them through 1-in. squares, as in the accompanying drawing. Rub the backs of the patterns with soft lead pencil to blacken them, and trace onto white cardboard, or use ordinary carbon paper, if you prefer. Then go over the lines of the face with India ink. Care must be taken not to emphasize the mouths too much, as they represent forehead lines also, and if they are too strong, both faces will be equally prominent, instead of the one right-side up being the more noticeable. Draw the clouds as boldly and modernistically as you please and cut them out, afterward blackening the edges, and paste the small cloud in front of the larger one.

Use a waterproof glue to paste the cloud assembly to the up-turned flap of the base piece, as shown in the perspective drawing. Before attempting to fold the cardboard, score the line with a dull knife, and no trouble will be experienced. Fold the main support or standard from a strip of cardboard cut  $1\frac{1}{4}$  by  $8\frac{1}{2}$  in. Paste the feet to the base, where they can be held with clothespins. To stiffen this unit, trace pieces to fit between, and glue them flush with the edges.

A wheel salvaged from a junked alarm clock serves as a bearing. The kind needed is the gear with the sleeve bearing that is mounted on the hand spindle. It is of such



bore that it will fit loosely on a sixpenny finish nail used for a shaft, but the wheel end must be reamed out with a drill to receive the head of the nail. Of course, the head can be filed down easily if the drill at hand is not the right size. Keep the fit loose, for the bearing must work freely. Glue the gear to the back of the disk at the center, first inserting the nail, and twist the latter with the fingers to be sure the glue does not adhere to it. The inclosed head prevents end play of the bearing on the shaft.

Now prepare the sensitive element. Obtain a small cardboard pill box, remove the cover, and fill with ordinary untreated salt—

the kind sold in cloth bags, which commonly becomes caked in salt shakers if there is the slightest moisture in the air. Lay a piece of coarsely woven cloth over the top and paste down the edges on the sides, for the purpose of holding the salt in but allowing free access of the air. Paste the box to the disk behind the mouth of the frowning face and as far from the center as possible.

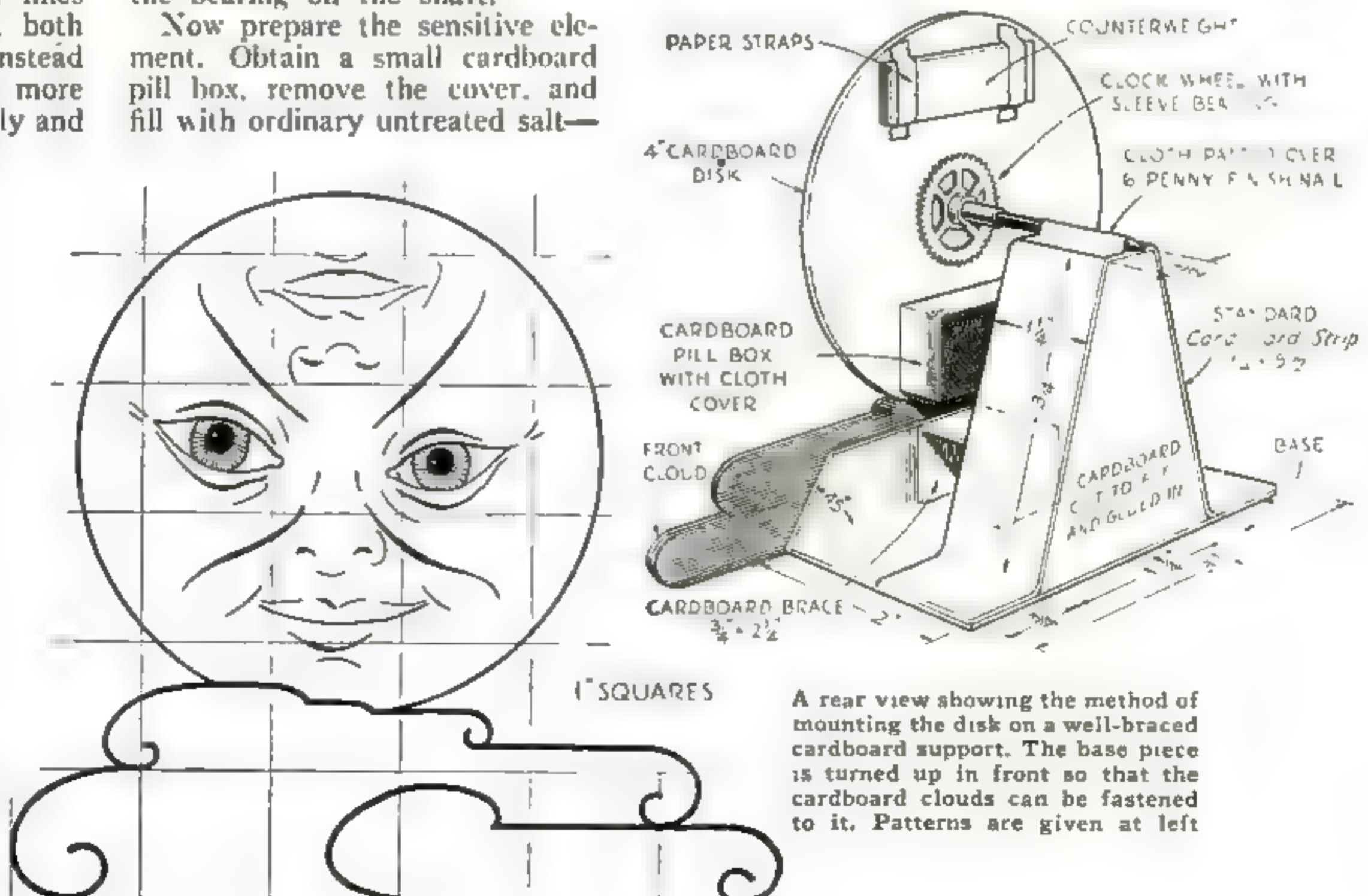
Counterbalance the salt with metal plates or nails, glued to the disk diametrically opposite. Add just enough weight to overbalance the face when the weather is fine—the bearing having been lubricated with sewing-machine oil.

If good weather is not at hand, dry the gadget well in a warm oven. On the other hand, to manufacture rainy weather, close the device up in a small box that has been drenched with water inside and has a can of water inside as well. If you have been careful with the bearing and if the counterweight was just sufficient to bring up the smiling face in the warm oven, incarceration in the damp box should turn the sour face right-side up.

The final step is to mount the shaft on the upright and secure it by gluing a piece of cloth over it. The clearance between face and cloud should be about  $1/16$  in.

The appearance of the midget weather prophet is improved by tinting the lips, cheeks, and cloud edges with a little water color. Waterproof the cardboard with a coat of white shellac or clear lacquer, and set it in an open window where the outside air can reach it.

If the bearing sticks now and then, jar it by tapping the standard with the finger.



A rear view showing the method of mounting the disk on a well-braced cardboard support. The base piece is turned up in front so that the cardboard clouds can be fastened to it. Patterns are given at left.

# Five Shop Machines Fold into a Portable Box

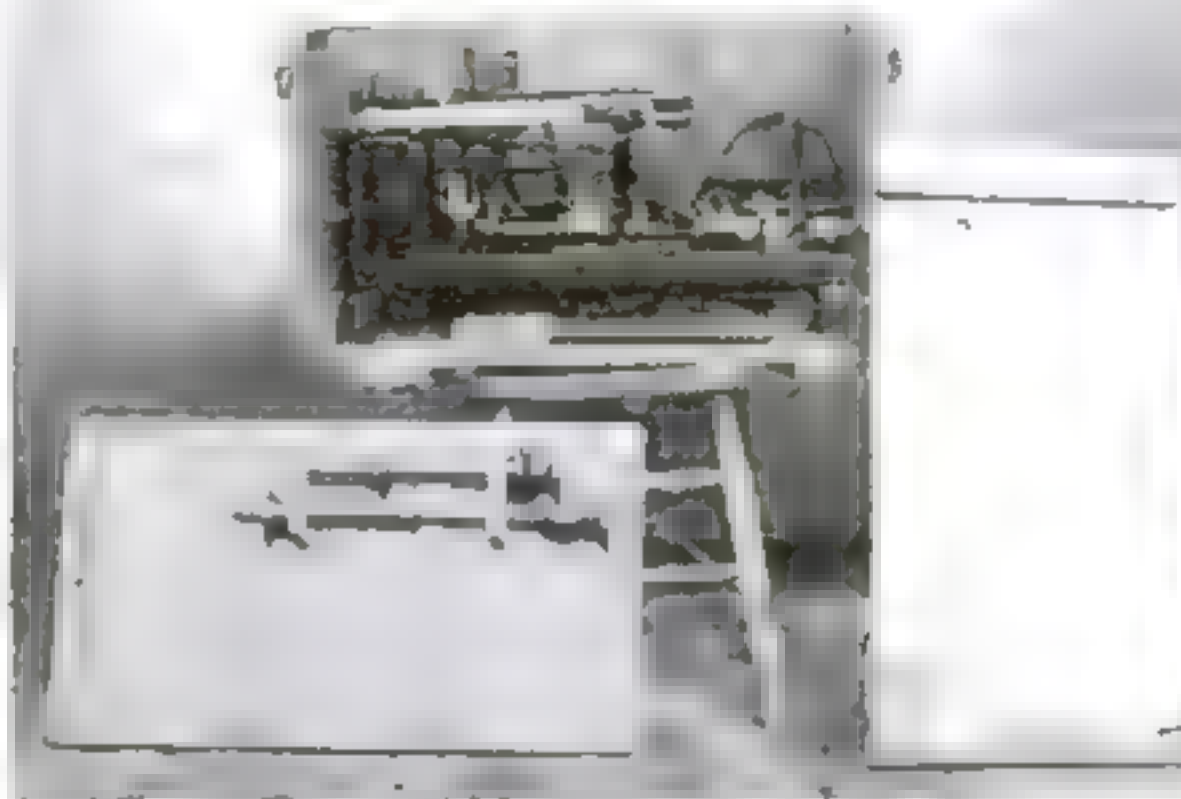
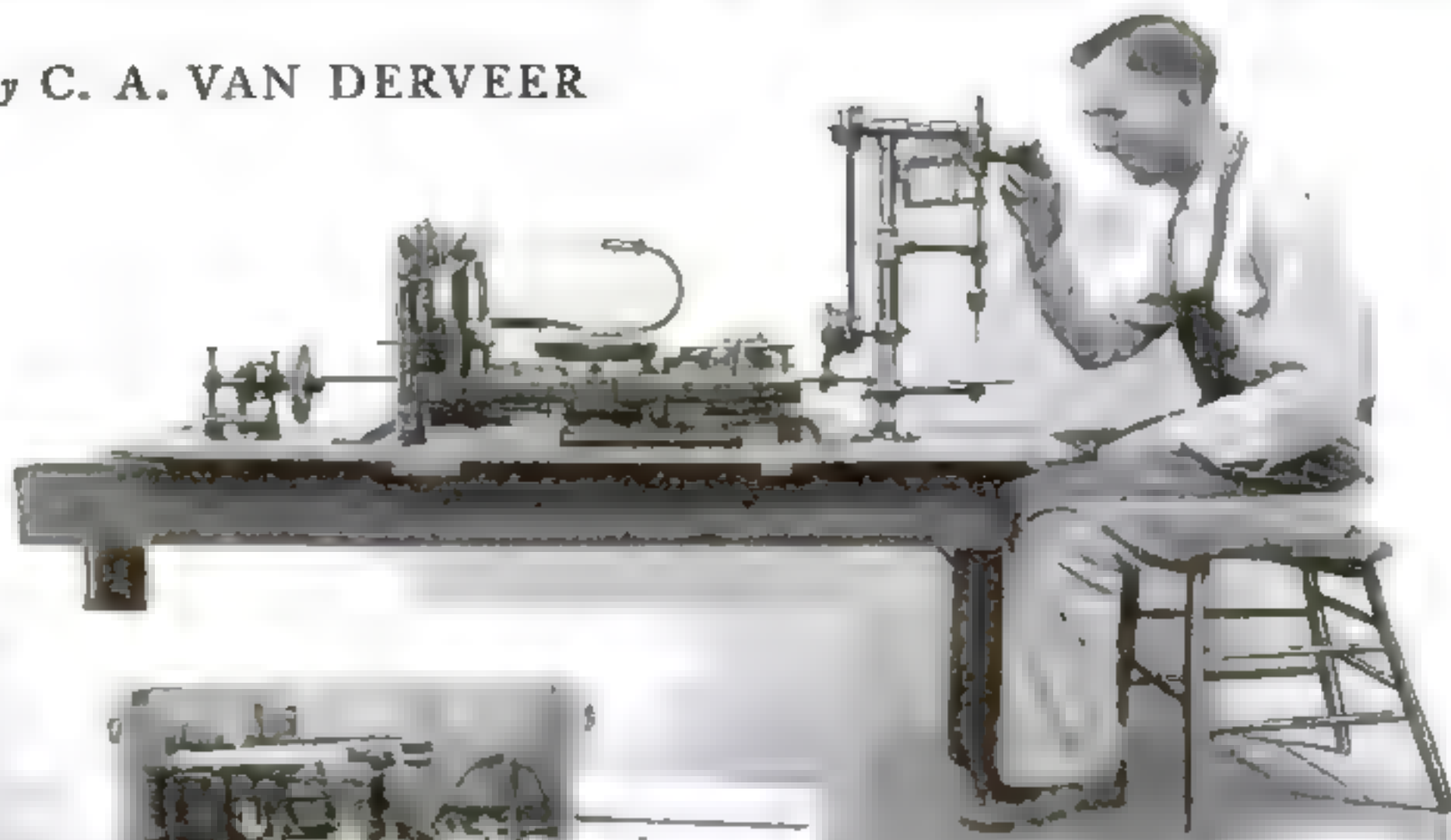
A PORTABLE workshop containing a drill press, lathe, emery wheel, jig saw, and circular saw, which folds into a box the size of a tool chest and can be placed on the running board of an auto. may easily be devised by anyone who wishes to take his shop with him from place to place. It can be set up on a table wherever a 110-volt 60-cycle plug is available and is ready to operate within a few minutes.

The photographs and drawing show the general layout. Ordinary  $\frac{3}{4}$ -in. boards are used throughout. Be careful that the various parts are perfectly square. It is necessary, of course, to put cleats on the boards to prevent splitting and warping; and these should be placed across the grain.

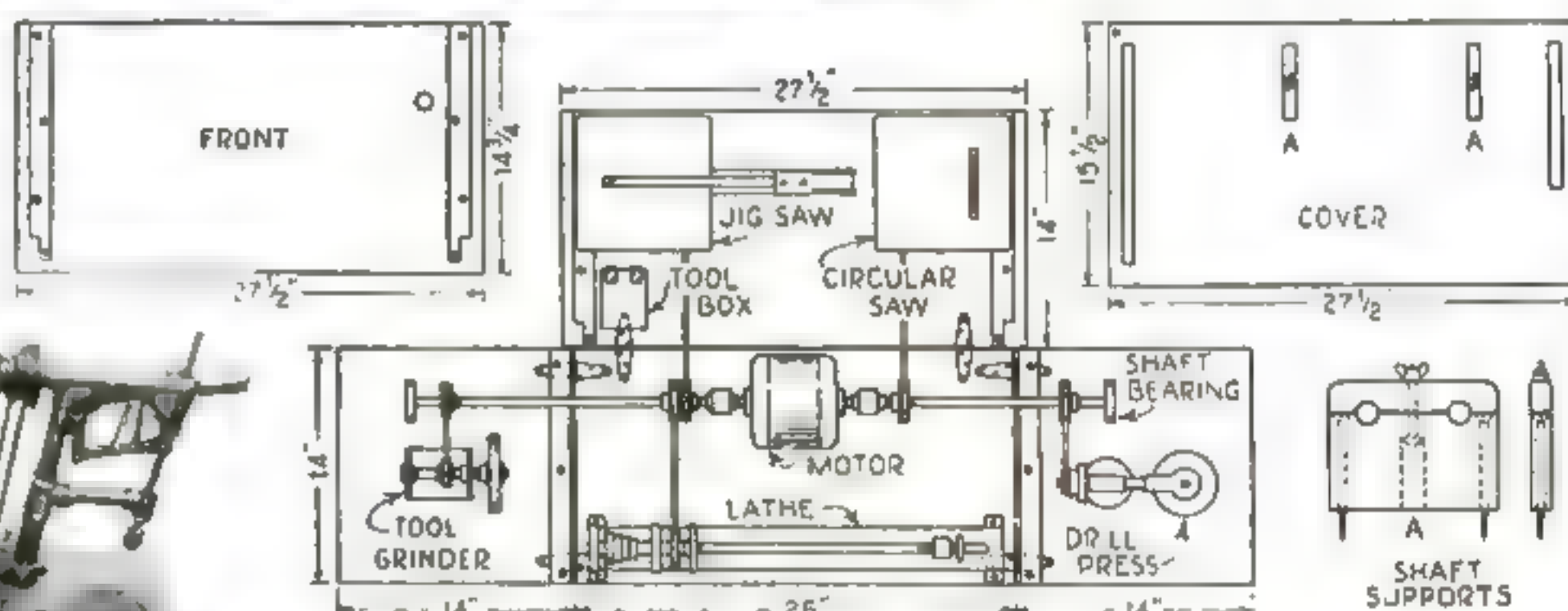
When the shop is to be moved, the shafts are uncoupled from the motor, removed from the bearings, and secured to the cover.

In most cases regular home workshop machines of the smaller sizes would be used, but the machines shown were built by the author from parts found in junk yards. The drill press, for example, was made of short pieces of pipe and pipe fittings, and a model-T Ford piston rod was used to form the adjustable table bracket. The drill press and lathe have four-speed pulleys. A motor with a double-ended shaft was purchased from a mail-order house.

By C. A. VAN DERVEER



The machines set up for use and, left, how they are packed in the box. The shafts are uncoupled and clamped to the lid. The outfit includes a small lathe, jig saw, circular saw, grinding wheel, and drill press.



The front and top or cover of the box are removed and the remaining parts are opened out flat by means of hinges so that the machines and motor may be set up as in the drawing above. The outfit is also shown in the photograph at the left.

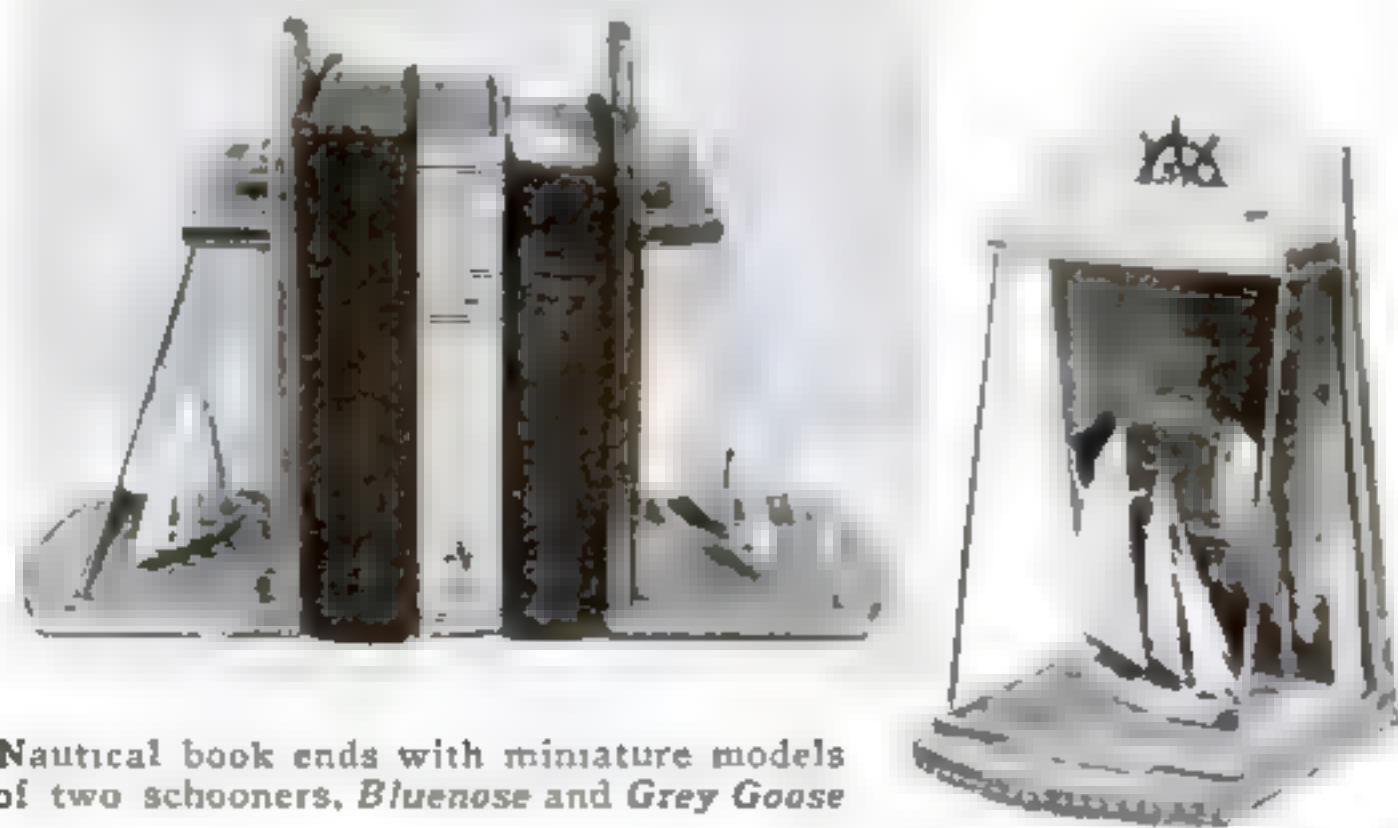
## MODELS INCASED IN GLASS BOOK ENDS

MINIATURE ship models may be made useful as well as ornamental by inclosing them in glass cases and using them as book ends. In the pair illustrated, the backpiece is  $\frac{3}{8}$ -in. pine, 5 in. wide and  $8\frac{1}{2}$  in. high; the base is  $\frac{3}{8}$  by 5 in. wide and  $4\frac{1}{2}$  in. long; and the top is  $\frac{3}{8}$  by  $1\frac{1}{4}$  by 5 in. Curves and other ornamentation may be added as desired.

Cut away part of the underside of the base and insert a lead weight or pour in lead shot and melted paraffin. Then drill four holes for 1-in. screws, which go through the base near the edge to secure the upright piece. The top of the case is held by three screws through the upright.

A piece of board  $\frac{3}{32}$  by  $4\frac{3}{8}$  by  $2\frac{13}{16}$  in. is painted on one

side to represent the sea and glued to the top of the base. Treat the top of case in a similar way. A piece of mirror is used for the background of one of the book ends illustrated, and the other background is painted on canvas. The side glass is  $5\frac{3}{4}$  in. high, 1 in. across the top, and  $2\frac{7}{8}$  in. across the bottom. The front glass is 6 by  $4\frac{3}{4}$  in.—O. G. SPAIN.



Nautical book ends with miniature models of two schooners, *Bluenose* and *Grey Goose*

## A NEW USE FOR OLD BRUSHES



Special-purpose brush made from an old toothbrush by cementing on a new celluloid handle

A SMALL, stiff-bristled brush for special cleaning jobs can be made from an old toothbrush. Remove the celluloid handle close to the bristles and cut off a piece large enough

to make a new handle of the type shown. By softening this piece in boiling water, it can be bent into a loop, which is then cemented to the back of the bristle section with acetone or celluloid cement. Round off any sharp corners with a file and restore the polish, if desired, by brushing the celluloid with acetone.

Handles of other shapes can be attached with equal ease if the brush is to be used in a restricted place and, of course, the bristles may be trimmed as necessary to suit the work.—EDWARD V. BURNHAM.

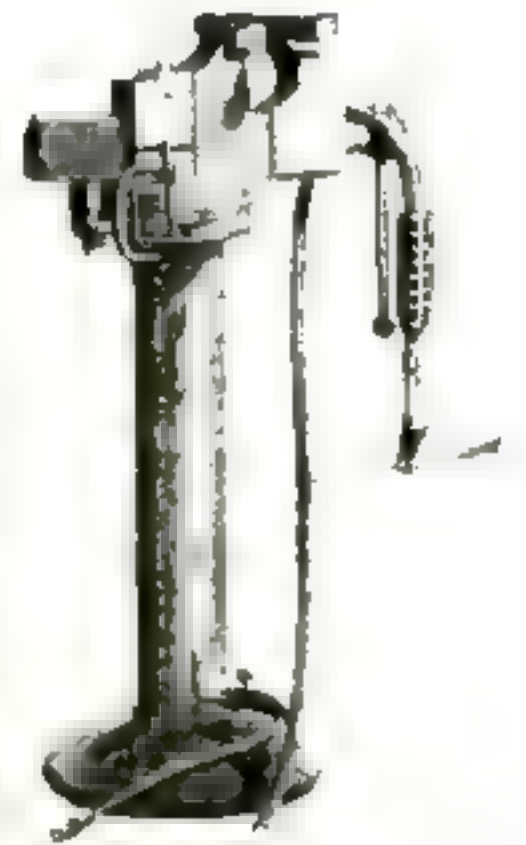
## MADE FROM SCRAP MATERIALS

with strap-iron braces welded on. The lower rails extend beyond the rear legs, bending downward to form mounts for two iron wheels about 3 in. in diameter, which are held on the axle with washers and cotter pins. The 1/2-in. pipes just below the top house rods which, when pulled out, act as handles for raising the table

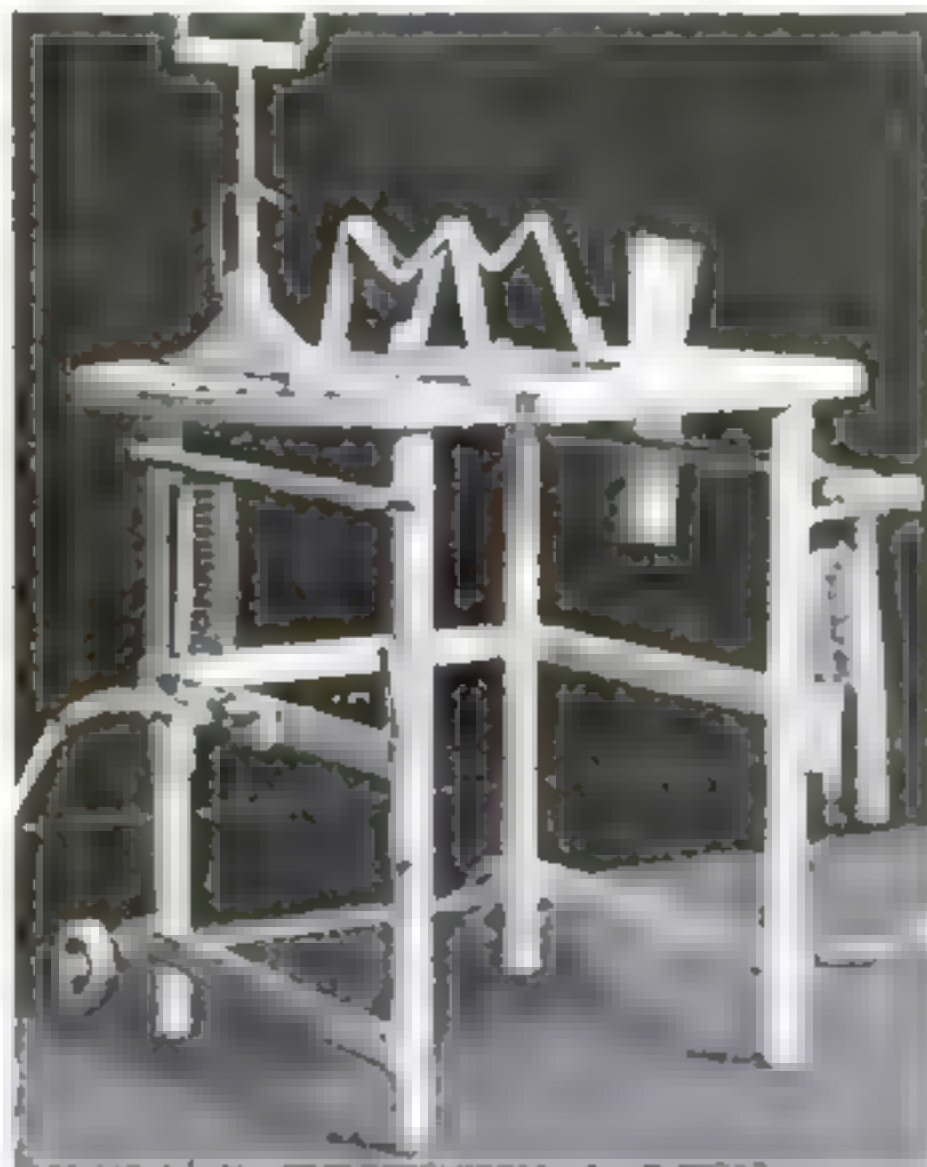
Pieces of tubing, welded to the legs, form sockets for hammer, wire brush, dusting brush, and chisel; and an angle on a lower rail is a handy projection for the ground clamp of an arc welder.

The accessories shown are also most useful. The can for electrodes was made of light tubing, the hook enabling it to be hung on the table edge at any convenient point. The little stand for propping work in an oblique or vertical position consists of a short  $\frac{1}{2}$ -in. pipe welded in an iron bell and provided with a wing screw for clamping the various holders in place. One holder is T-shaped, the cross bar made of 1-in. angle iron with the ends turned up for catches. Another holder terminates in a short angle iron forming a V; and a third is forked horizontally. The one with the carriage clamp is valuable for many jobs. For cylindrical work, the trunnions, which are bent from  $\frac{1}{4}$  by  $2\frac{1}{2}$ -in. flat stock, are handy.

An added convenience is the vise stand, used in conjunction with the table. The base of this one was made from a junked manhole cover, and the column from scrap tubing. A piece of 3/16-in. sheet stock welded to the top and pierced with holes for bolts carries a machinist's vise with jaws about 4½ in. wide.



Portable vise with ground-clamp connection near base



**Welding table and various accessories. Note the telescoping handles for moving the bench**

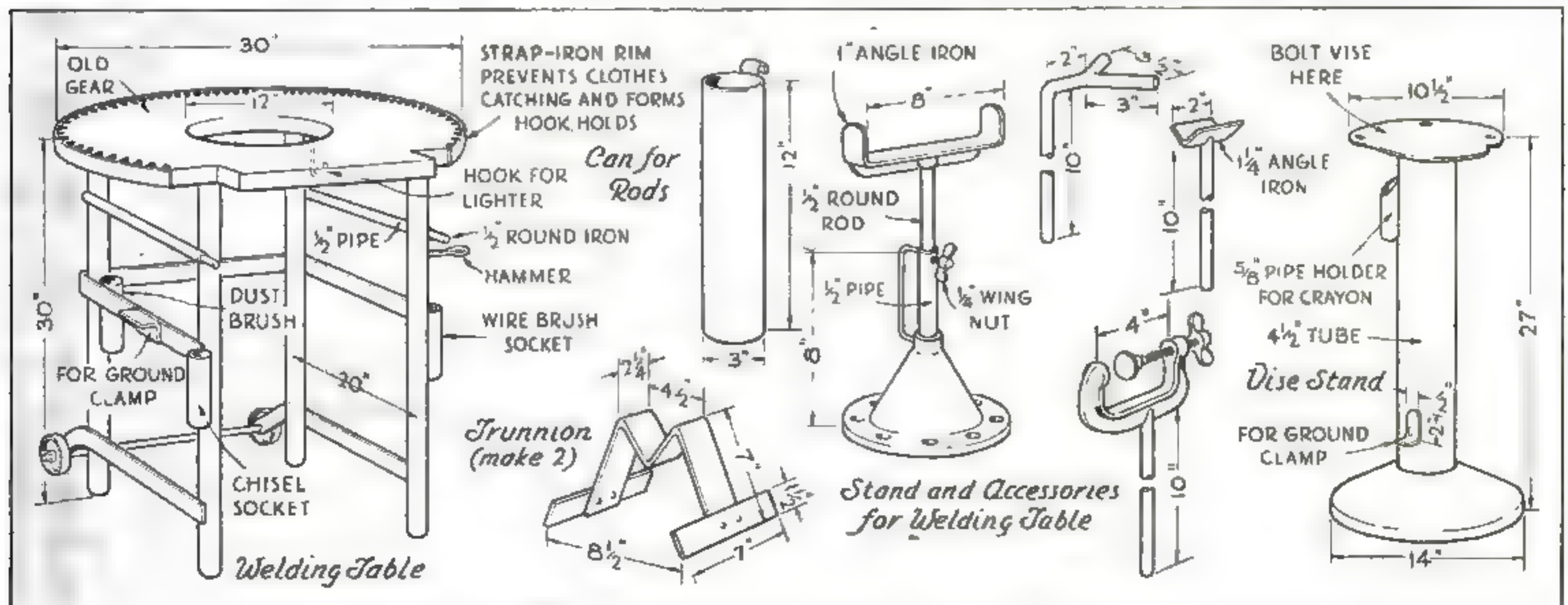
**Welder at work on gear resting on bench. Note vise stand**

**M** ECHANICS who have examined this welding table regard it as the most convenient and practical equipment of its kind they have found outside of expensive factory installations. It certainly has proved itself invaluable in daily service in the shop where it was built. From time to time various alterations have been made in it to improve the design, but the cost was low because most of the materials used in its construction were salvaged from the scrap and junk bins.

Many uses other than welding can be made of the bench. The large center opening makes it ideal for truing up warped disk wheels, as draw bolts can be inserted from underneath.

The top of the bench was made from a large discarded gear wheel. One side was cut straight with the torch, leaving 3-in. offsets at the ends. A 1/4-in. iron strap was welded around the remaining toothed perimeter, forming convenient hooking pockets for accessories and also preventing the clothes of the mechanic from being torn on the cogs.

The frame was built of 1½-in. pipe,



How the table is made with an old, thin gear for the top; sketches of a variety of work-holding devices; and a portable stand to support the vise

HISTORIC

# Gettysburg

## How to Construct a Scale Model



The gun which this little model represents stands today in its original position on Barlow's Knoll

**E**VERY model builder who is interested in old cannon or in the Civil War will want to add to his collection this accurate model of one of the guns preserved on the Gettysburg battlefield. The model is made on a scale of  $\frac{3}{32}$  in. equals 1 ft., and is  $11\frac{1}{2}$  in. long. It is mounted on a mahogany base 10 by 13 in.

This particular gun stands on Barlow's Knoll, where Battery G, Fourth United

States Artillery, was stationed under the command of Lt. Bayard Wilkeson. The fire of thirty-six Confederate cannon was turned on this position. Wilkeson's leg was almost severed by a shell, and he completed the amputation with his own hands and a penknife. The knoll was finally captured, and during the night Wilkeson crawled back to the Almshouse buildings, where he died.

The wheels of the model are not dished,

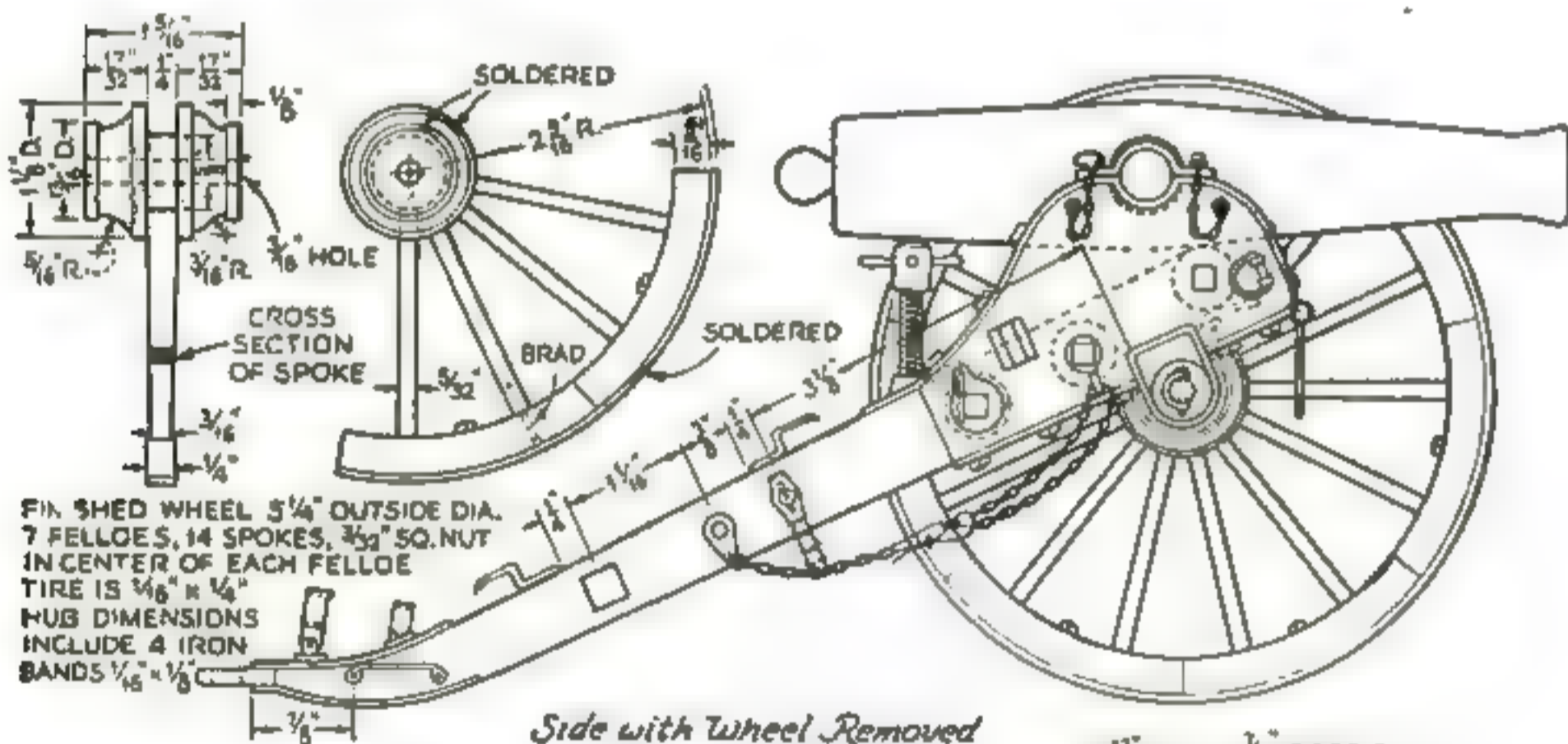
but flat. The felloes are cut in one piece from  $\frac{1}{4}$ -in. plywood (or you can make seven felloes, if you prefer). The spokes are  $\frac{5}{32}$  in. thick and taper in width from  $\frac{1}{4}$  in. at the hub to  $\frac{3}{16}$  in. at the rim. They are rounded as shown except for the  $\frac{1}{4}$  in. that extends into the hub.

The hubs are turned in one piece and banded with four metal bands  $\frac{1}{8}$  in. wide and  $\frac{1}{16}$  in. thick. The dimensions given for the hubs include the  $\frac{1}{16}$ -in. thickness of the bands. It will be well worth the extra time it takes to bush the hubs with  $1\frac{5}{16}$ -in. lengths of  $\frac{3}{16}$ -in. inside diameter tubing.

Make a jig by laying the wheel out on a board and boring a  $1\frac{1}{8}$ -in. hole  $\frac{17}{32}$  in. deep to hold the hub's  $\frac{1}{4}$ -in. spoke groove flush with the surface of the jig. By drilling a  $\frac{3}{16}$ -in. hole the rest of the way through the jig, the hub can be bolted firmly in place. Drive small brads in the jig on each side of the spokes about  $\frac{1}{4}$  in. from the circle where the spokes meet the rim. Now tap the spokes in place in the hub and let the ends rest between the brads. Drill small holes through the felloes and into the spokes for  $\frac{1}{2}$ -in. brads.

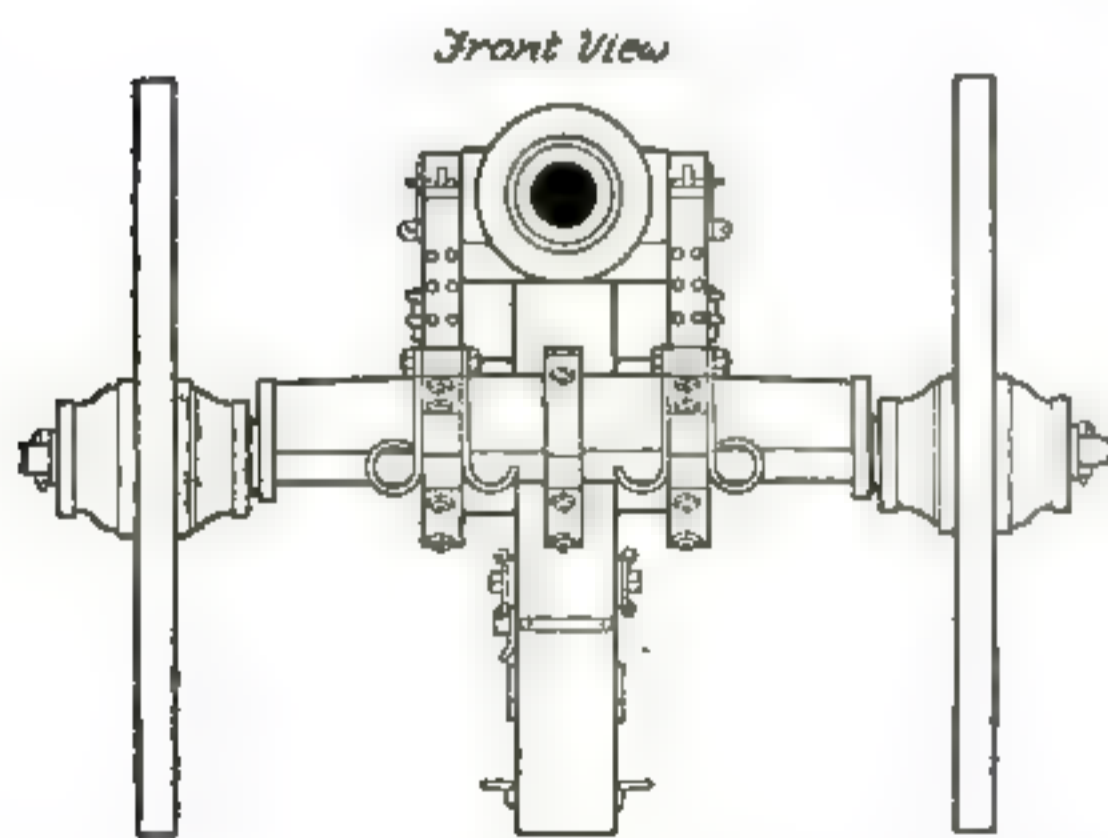
The tire should be pressed on while the wheel is still on the jig. The tires can be made of  $\frac{1}{16}$  by  $\frac{1}{4}$ -in. strips of metal by filing a  $\frac{1}{2}$ -in. taper on each end and soldering the tapers together. The small  $\frac{3}{32}$ -in. square nuts in the center of each felloe are made of cardboard and glued in place.

The wooden part of the axle is  $\frac{1}{2}$  by  $\frac{9}{16}$  by  $4\frac{1}{4}$  in. The  $\frac{9}{16}$ -in. side is tapered on each end to  $\frac{1}{2}$  in. square at the ends, leaving a 2-in. flat surface at the top for the two sides and the tongue to rest

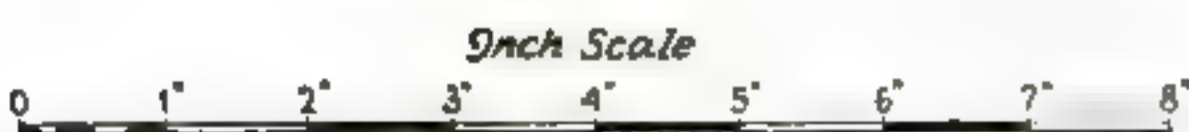


FIN. SHED WHEEL  $5\frac{1}{4}$ " OUTSIDE DIA.  
7 FELLOES, 14 SPOKES,  $\frac{3}{32}$ " SQ. NUT  
IN CENTER OF EACH FELLOE  
TIRE IS  $\frac{1}{8}$ " x  $\frac{1}{4}$ "  
HUB DIMENSIONS  
INCLUDE 4 IRON  
BANDS  $\frac{1}{8}$ " x  $\frac{1}{16}$ "

Side with Wheel Removed

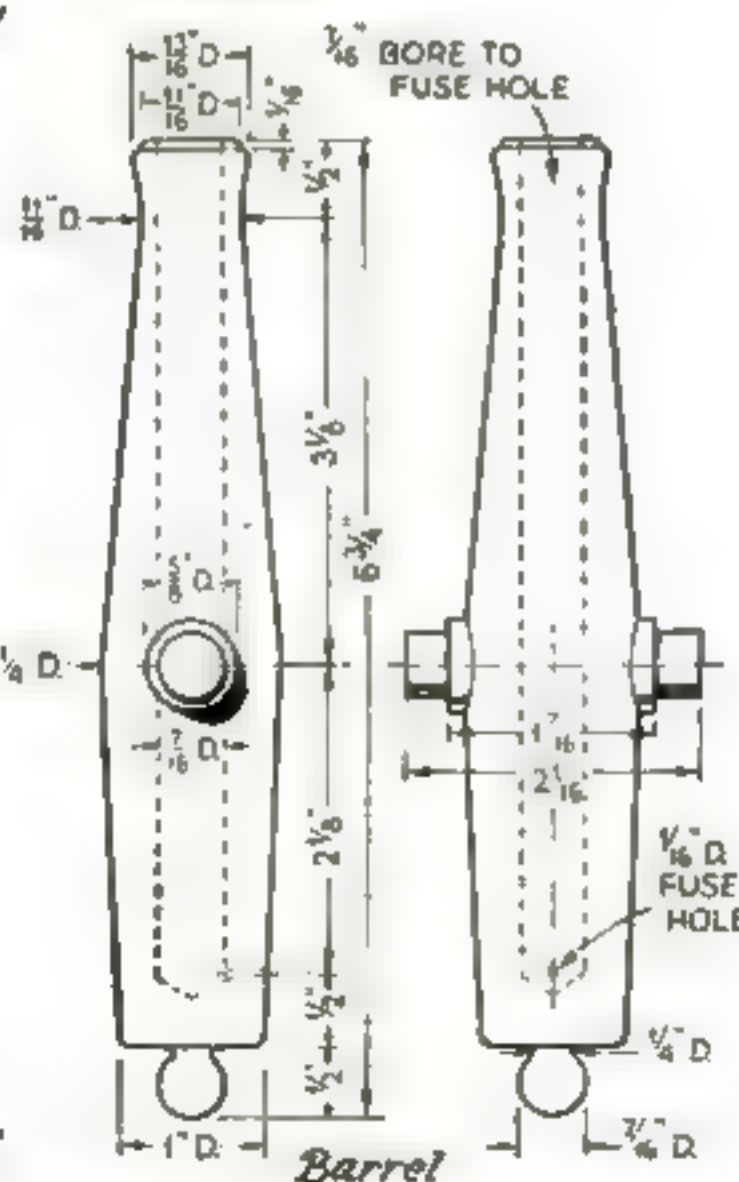


Front View

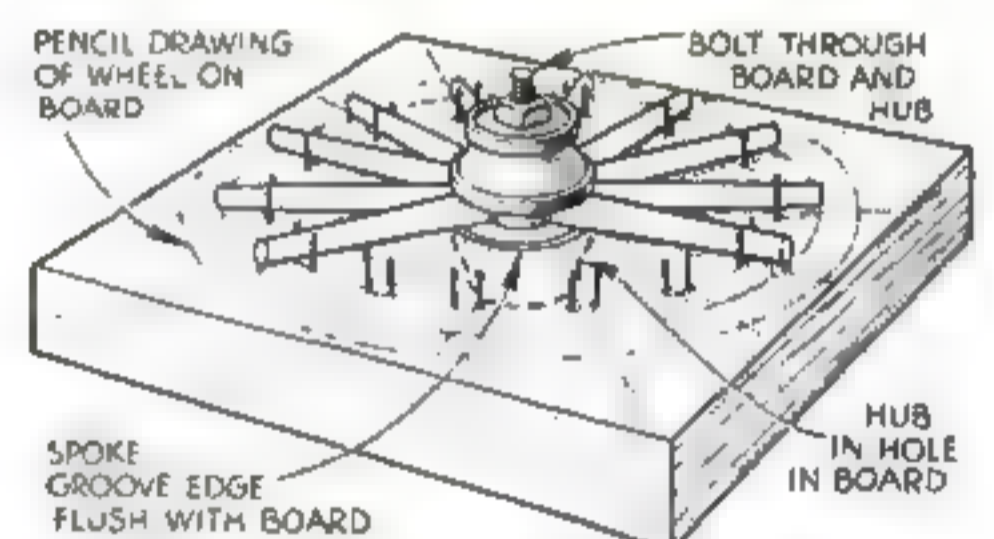


Inch Scale

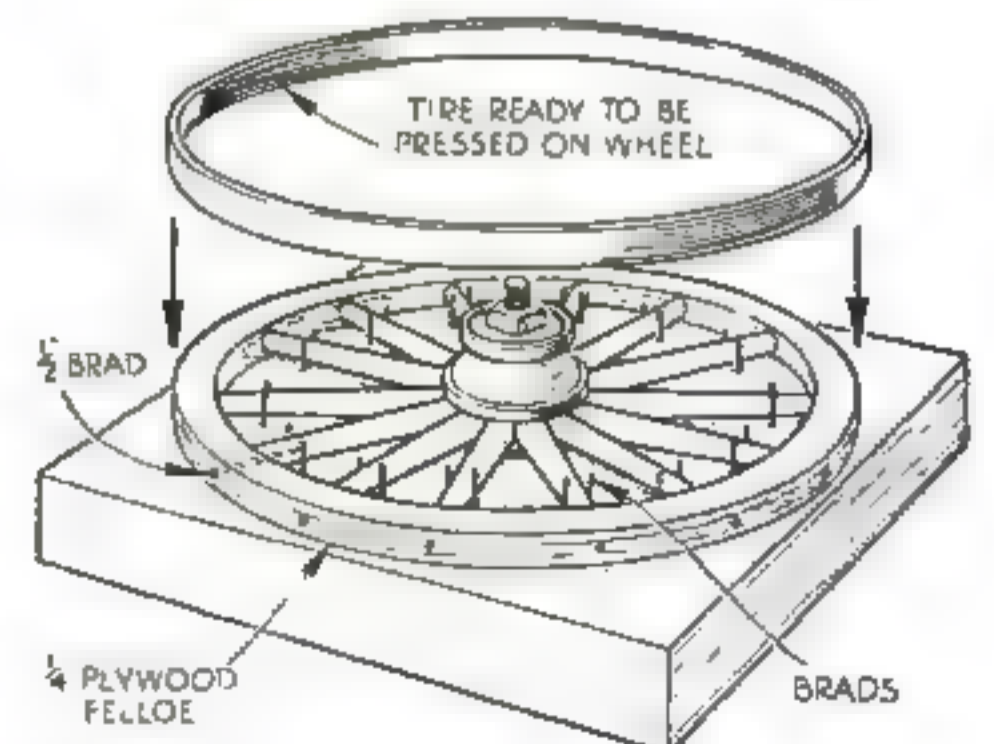
Side and front views of the model, and details of the wheels and gun barrel, with a scale in inches



Barrel



How Wheels are Assembled



The correct way to make the felloes is to use seven pieces, but it is simpler merely to cut a one-piece ring from  $\frac{1}{4}$ -in. plywood

# Cannon

REPRODUCED  
IN MINIATURE

## of a Picturesque Civil War Gun

By  
CARL G. SENF

on. The underside has a  $\frac{3}{16}$  by  $\frac{3}{16}$ -in. slot or groove running its entire length to accommodate the square part of the metal axle, which is merely a  $7\frac{5}{8}$ -in. length of  $\frac{3}{16}$ -in. square rod turned or ground to  $\frac{3}{16}$  in. round where it extends past the wood. The tips also are rounded on the ends. The wood and iron part of the axle are held together by a  $\frac{1}{8}$  by  $\frac{1}{16}$ -in. band on each end of the wood, filed from a piece of  $\frac{1}{8}$ -in. metal.

Pins for retaining the wheels in place are  $\frac{1}{16}$ -in. roundhead rivets with two sides of the head filed flush with the shank. The locking strip is cut from  $\frac{1}{32}$ -in. sheet metal; it is  $\frac{1}{16}$  in. wide and slightly larger and rounded at the end where it is riveted to the pin. Rivets may be made from  $\frac{1}{2}$ -in. pins cut off to the desired length. The  $\frac{1}{2}$  by  $\frac{1}{16}$ -in. washers go behind the wheels, and the  $\frac{3}{8}$  by  $\frac{1}{16}$ -in. washers go between the wheels and the locking pins.

The tongue is  $\frac{11}{16}$  in. thick. Cut it to the shape shown, being very careful to have the  $\frac{1}{4}$ -in. offset at the head square with the sides. Also drill the three holes for No. 4 bolts exactly square with the sides of the tongue.

Next drill and file the towing ring to the shape shown from a  $\frac{11}{16}$  by  $\frac{11}{16}$ -in. square of  $\frac{1}{8}$ -in. metal. The top and bottom plates are  $\frac{1}{16}$ -in. sheet metal bent to shape and riveted to the ring by two  $\frac{1}{16}$ -in. rivets, countersunk at top and bottom.

The two blocks with the tapered rings can be made as follows: First prepare the flat bases. Then solder two  $\frac{1}{8}$  by  $\frac{1}{8}$ -in. lugs, rounded at the top, to the block nearest the ring. Now put the towing ring and plates in position on the tongue, clamp the two small blocks on the top plate, and drill a  $\frac{1}{16}$ -in. hole in each end of both blocks. These holes are drilled all the way through the top and bottom plates. The  $\frac{1}{16}$ -in. roundhead rivets that hold the blocks in place also hold the top and bottom plates in position on the tongue. The bottom plate is countersunk. To hold the ring and plates tight against the wood while drilling, I ran a piece of wire through the ring and around the end of the tongue and drew it tight with a small turnbuckle.

**T**HE tapered rings can be shaped by bending metal strips around a tapered stick, and filing them to the desired shape. Leave an extension on the largest ring to be pinned between the lugs on the block. This completes the larger ring, and the smaller ring can now be soldered by holding it in place with a tapered stick passed through the larger ring.

For lifting, make the grips of  $\frac{1}{16}$ -in. wire bent to shape and hammered flat on the ends, where they are drilled and fastened to the wood by small brads. The two cleats, clip for the chain ring, and rub plates are made of  $\frac{1}{16}$ -in. sheet metal and fastened as shown in the side view.



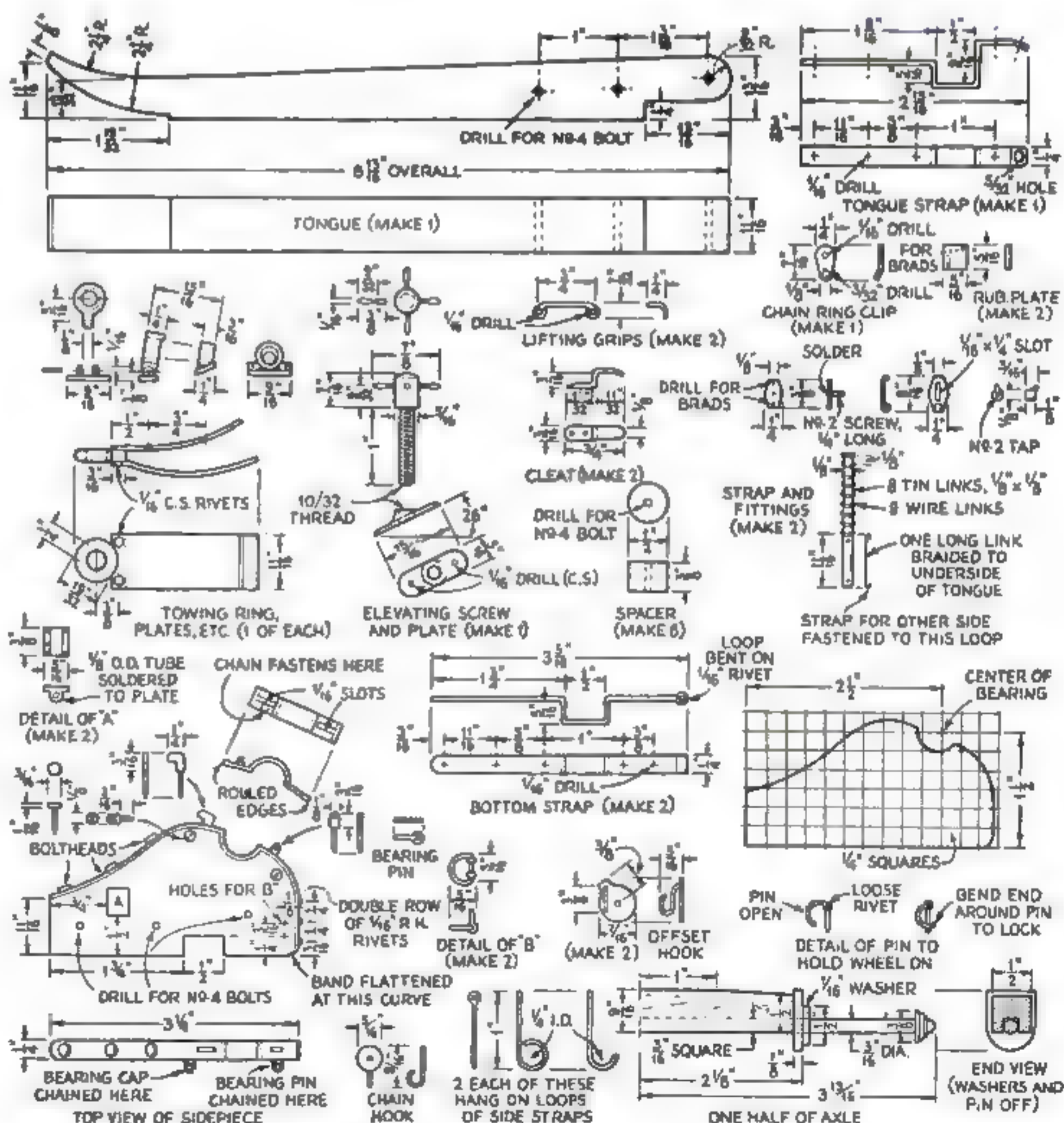
The disassembled model with carriage upside down to show the straps and axle

The cleats are bradded in the center of the tongue. The rub plates are bradded in place also. The chain-ring clip has a small washer slipped over the brad to represent a large round flatheaded pin.

Wherever brads are used, the heads

should be sunk below the surface of the metal and filed flush.

The strap plate, which has a No. 2 countersunk screw extending from its surface, is  $\frac{1}{32}$ -in. metal, fastened on the tongue with brads. (Continued on page 94)



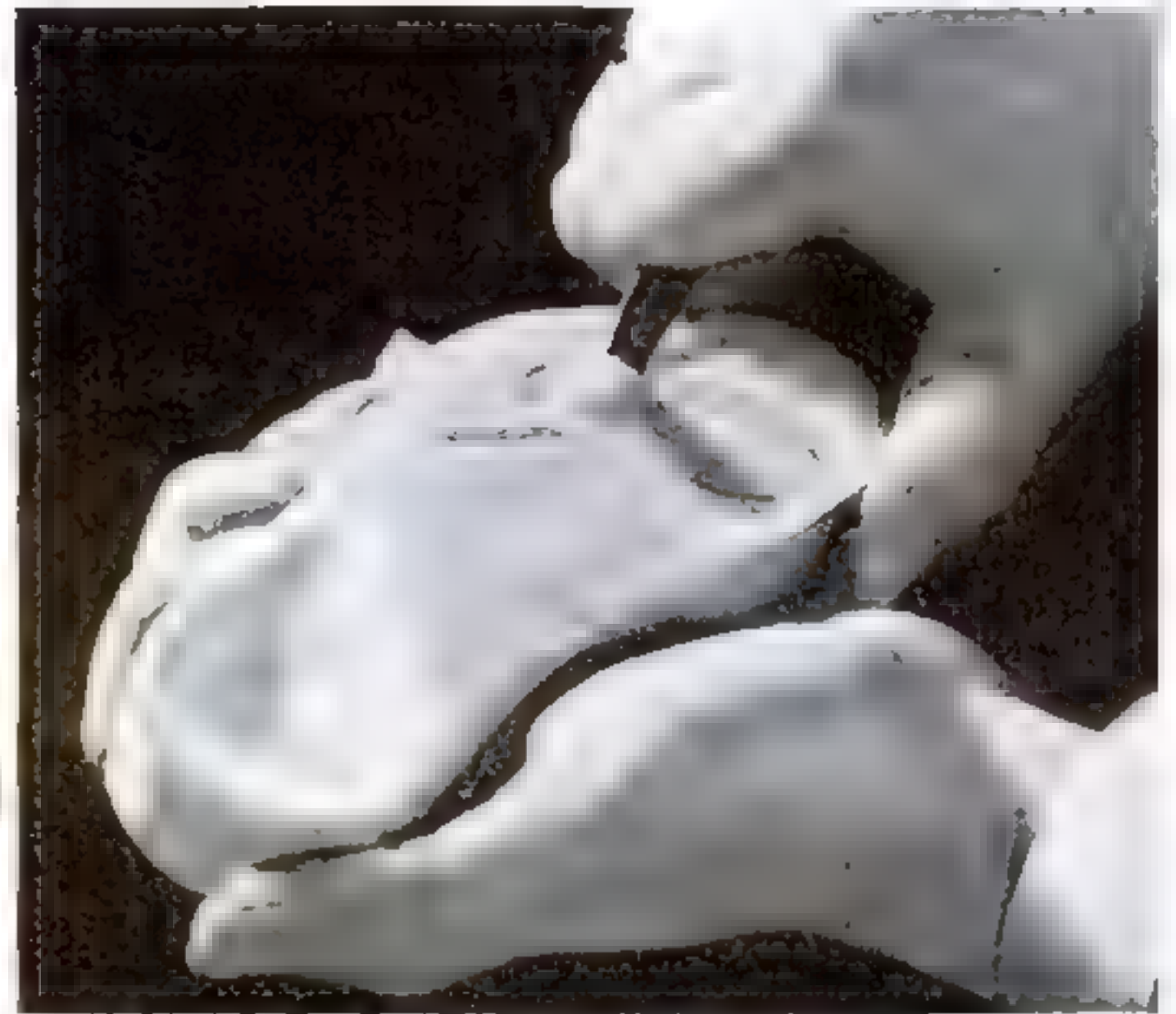
Working drawings of the tongue, sidepieces, bearings, axle, straps, and all the smaller fittings

# Whittled Wooden Shoes

... For Use as Ornaments or  
in Place of Beach Sandals



Here are two types of sandals. Directly above are a pair of general utility sandals with monogrammed straps, while at right are two French sabots for a child



The finished heel pad, and method used in cutting out the ball pad

**T**HERE is something romantic about wooden shoes—probably because most of us have never worn them. To make a pair is therefore an unusual and interesting whittling project. When finished, they can either be used as ornaments or actually worn in place of bathing sandals or garden shoes.

In Germany, my Hanoverian grandfather turned out *Holzschuhe* by using double-handled, shaped drawknives for carving the exteriors and long-handled spoon chisels to hollow the solid wood, but shoes of similar appearance may be made in built-up form with little more than a pocketknife.

Use any  $\frac{3}{4}$ -in. wood for the soles. Maple is a good, long-wearing hardwood,

By E. J. TANGERMAN

although white pine and basswood are much easier to work and wear very well. Draw the outline as at A, Fig. 1. Indicate the line of the ball of your foot and the center of your heel, or step on the outline with a wet foot, which will show the two principal resting points. Draw a line across the grain as at B, and a rough outline of the center pads, as at C. These must be hollowed out so that the foot will rest comfortably.

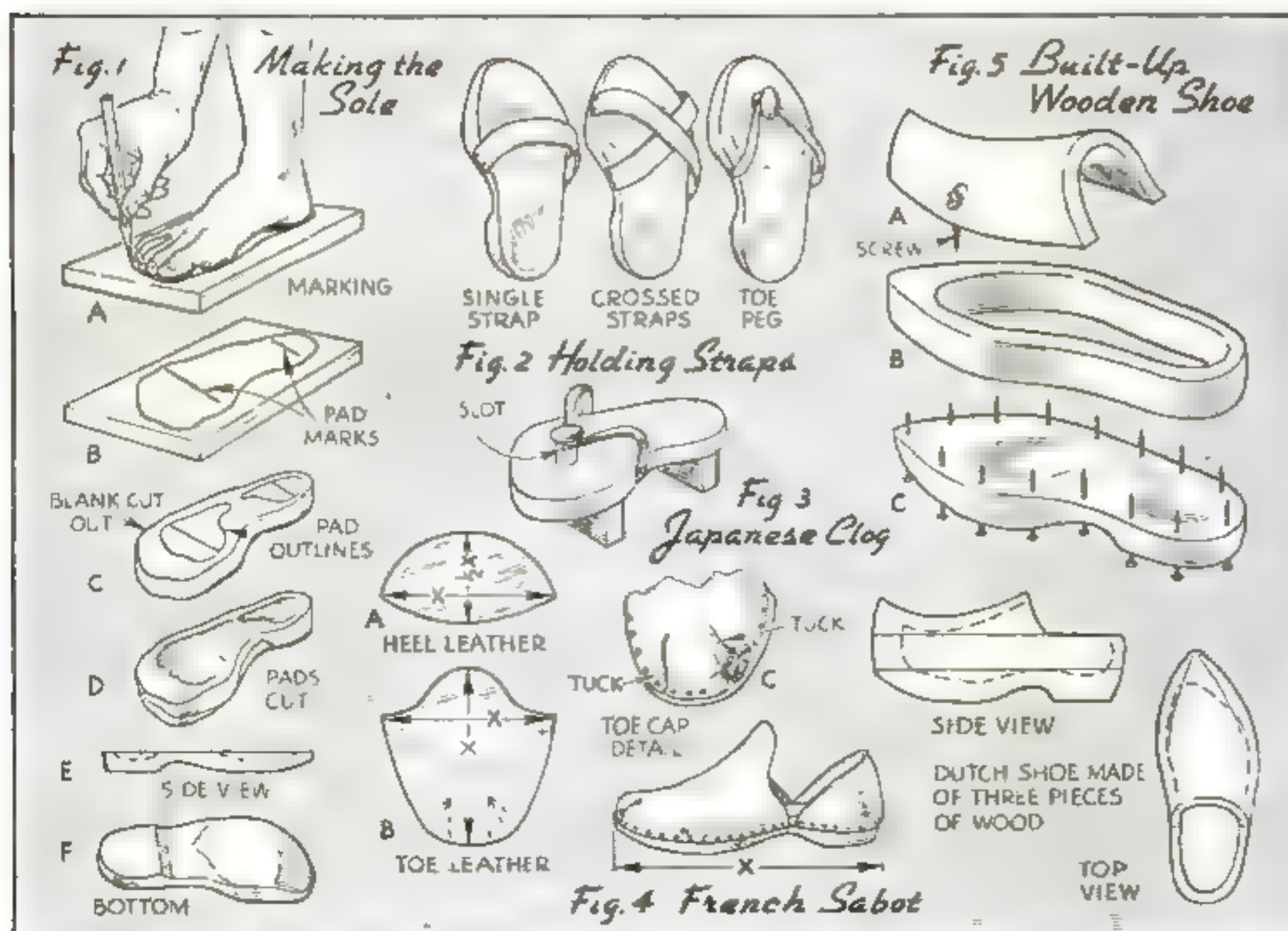
Whittle or saw out the outline and depress the ball and heel pads as shown at D, Fig. 1, by making a stop cut across the piece on the center line and cutting to-

ward it from each side. These pads can be sunk about  $\frac{1}{4}$  in. and should be extended toward each other at the outside of the foot. You can tell when you have the correct shape by testing until the sole fits your foot. Then sand the hollows until smooth.

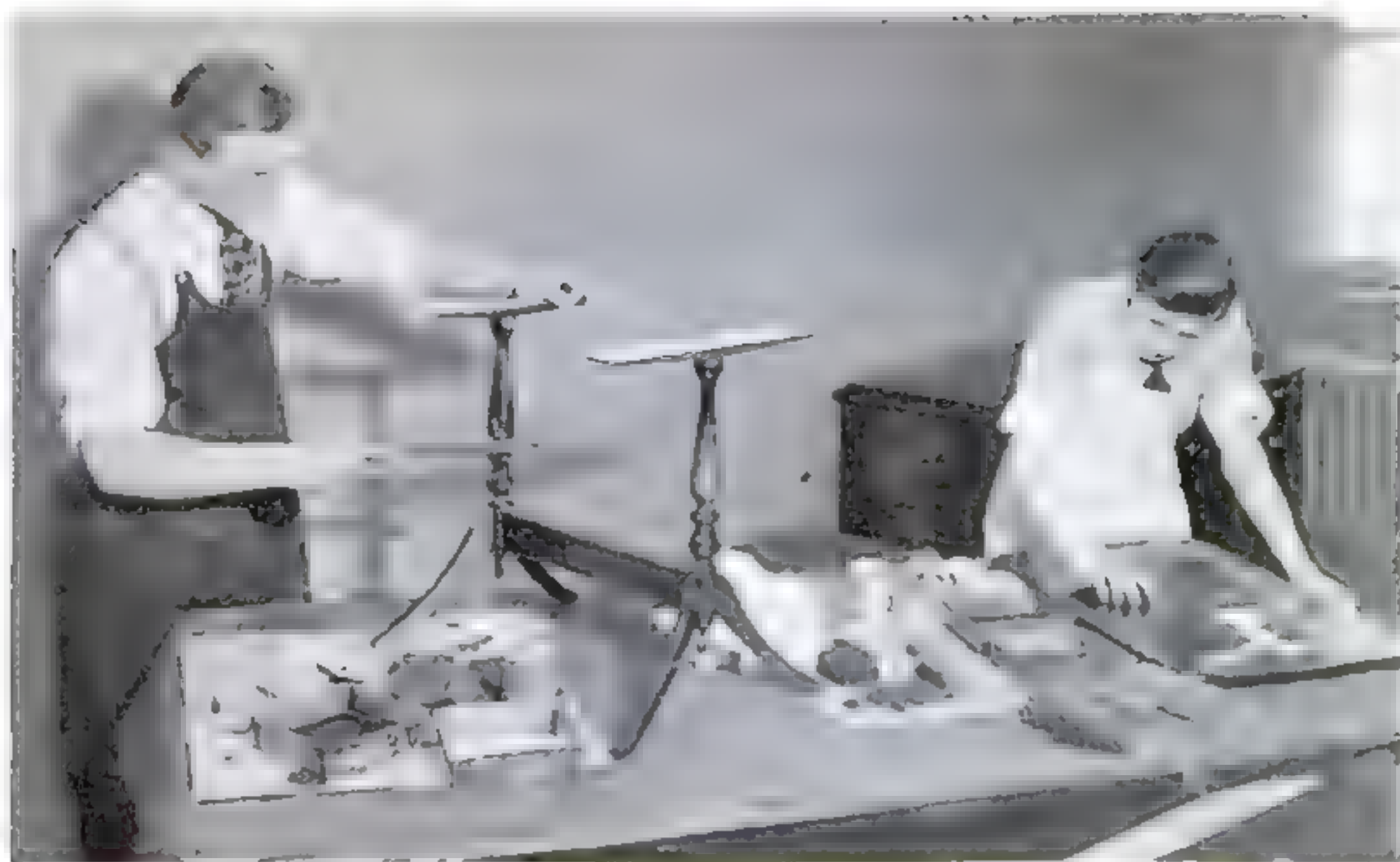
Next mark a heel on the underside of the sole, make a stop cut across, and cut away under the instep to bring out the heel, as at E and F, Fig. 1. Also cut away under the toe or you'll have trouble walking later.

To make a simple sandal for beach or bath use, tack on a holding strap of any leather that is available. The single strap in Fig. 2 is simplest, but does not hold the sandal in line with the foot as do the cross straps. A third arrangement that comes from the Far East is the toe peg, which is streamlined to fit between the great and second toes. Make it look like a toadstool and fit it into a drilled hole; then thin it slightly at the sides so it isn't so noticeable between the toes. Cut a slot just under the head, and run a thong through this slot back on each side. This makes a surprisingly comfortable shoe. It is also possible to use braided reeds or tough grass, cloth, or soft rope for the straps. If you use leather, you can decorate it with initials or monograms by pressing simple dies into the wet leather. Finish with lacquer or paint.

The simple wooden sole is also the base for the French sabot (Fig. 4). This is quite comfortable and easy to wear. The sole has toe and heel caps tacked in place. Their general shape is indicated in the drawing. They will vary with the size and shape of your foot, of course, but the toe leather is about 1 ft. wide by 1 ft. long, while the heel leather is a little short of 1 ft. wide by 6 in. high. Use some fairly thin and flexible leather, such as sheepskin, heavy chamois, or light side leather like that (Continued on page 85)



Using the simple wooden sole as a base, it is easy to duplicate the footwear of many nations



Pads and other materials should be placed on sheets of paper to protect them from grit. The worker on the left is using a rubbing brush for hard-to-get-at places while the other one is rubbing the table top

# A Satin Finish

## FOR YOUR FURNITURE

**W**HEN a piece of furniture or other woodwork has been stained, filled, and varnished as described in the three preceding articles of this series, it is ready to be rubbed down to a beautifully level and soft-sheened surface resembling plate glass in depth.

It is unwise to attempt the final rub-out with less than three coats of well-dried varnish on the work. Even with so-called "four-hour" varnishes it is best for amateurs to allow a week between successive coatings. Practically all failures in varnish films are the result of malpractice in this respect.

We have learned that a dry, single thick 6/0 garnet paper should be used for rubbing the first coat, and a water-wet 6/0 or 8/0 finishing paper of the so-called "wet-or-dry" type on the second and possibly in part on the third or last coat. This last-mentioned paper is fast cutting, and when "backed-up" by a 1-in. rubbing felt will do much to level all parts of the varnish surface previous to the last coat, which should flow out absolutely level.

Each speck of dust or lint causes the varnish to pile up into a tiny mound or ridge above the general surface of the film, two to three times as thick as normal. When the body of the varnish is perfectly dry and hard throughout, the "nib," as it is known in the rubbing shop, is only surface hardened. If such a surface is rubbed with pumice stone and water or oil, the pad and pumice cut off the top of the nib, and the soft core pulls out and adheres to the pad as a tiny glazed spot; and when the surface is washed off and dried, the varnish appears to be pricked with pin-holes here and there. This is what the practiced rubber calls "pull-outs." If such

a surface had been lightly water rubbed and redried several days more, the chances are that no pull-outs would have occurred. Hence I advocate that you allow at least a week between coats in a room 75 deg. F; and if not impatient, allow ten days for the last coat. The surface will be easier to rub, and the sheen will be far richer.

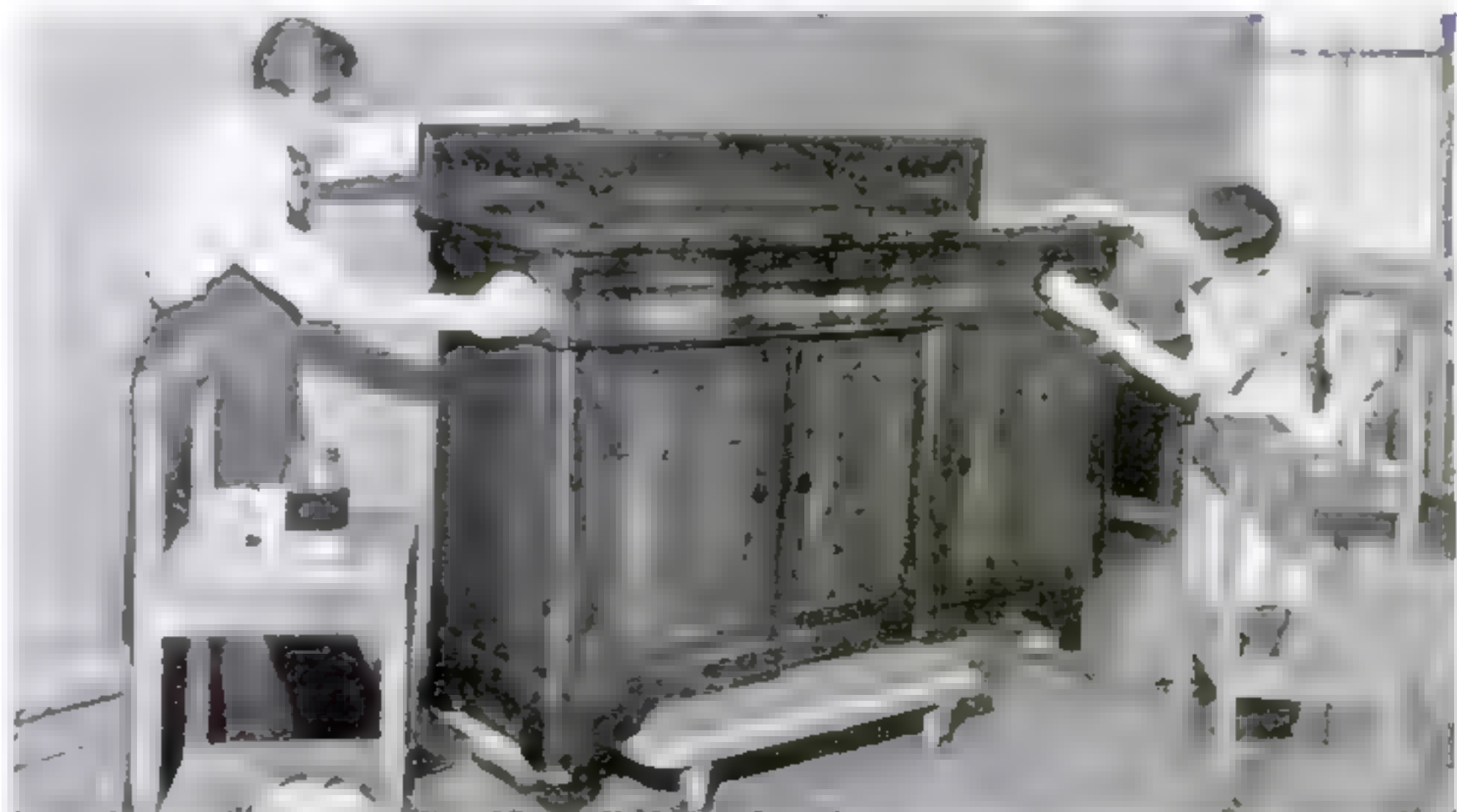
In testing for adequate drying, the experienced rubber will press the pad of his thumb carefully but firmly against any doubtful hardened portions, withdraw, and then wipe the surface to remove the thumb-oil print so that he can determine whether or not the warmth and pressure have left a noticeable thumb mark in the gloss of the varnish. If such is the case, more time must be allowed for drying

and hardening.

On the margins of any portions where "fatty edges," sags, or drips have occurred, use the thumb or thumb-nail test to determine the actual hardness of the material. If a print is produced by either method, give the varnish more time for drying. Fairly hard sags or fatty edges may be partly cut down for further drying by using 6/0 wet-or-dry paper and lubricating the sandpaper by first rubbing it on a bar of pure white soap. Use the side of the thumb frequently to squeeze off the water and soap over the sags by a quick sidewise stroke toward the body. *(Continued on page 96)*



Before starting work, make sure that you have everything prepared on a suitable stand



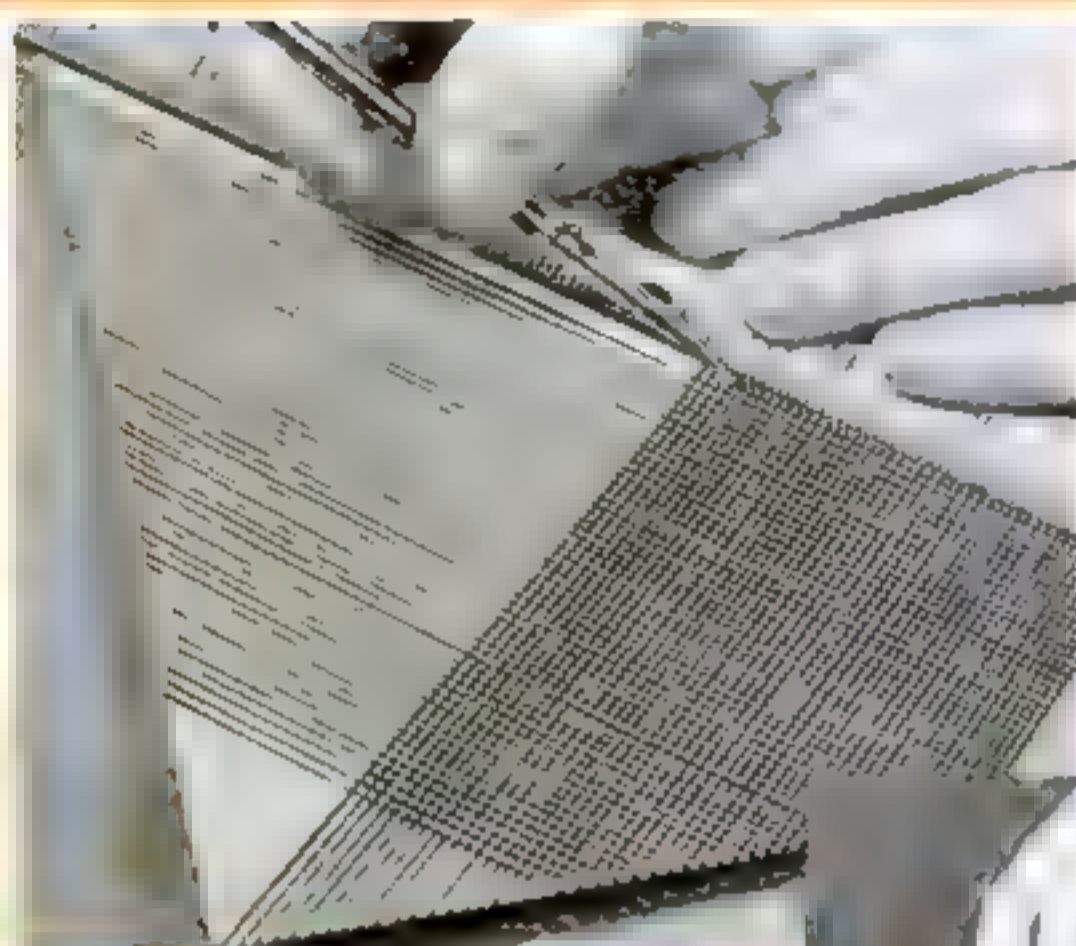
An old cotton flannel dipped in water, wrung out, and coated with polish is being used at the left for a final clean-up. The worker on the right is spot-rubbing where necessary after an inspection

# HALF-TONE

*EASILY MADE WITH*



Examining dot formation with linen tester. The "view" camera in this case has a homemade screen-holding back



The first step in making a half-tone screen is to rule equally spaced diagonal cross lines on white cardboard

After being sensitized, the screen glass is held over a gas burner at the angle shown below. Do not allow it to become overheated



At left: The sensitized glass is exposed under the half-tone screen negative. Daylight may be used, but is somewhat slower



**Z**INC half-tone engravings, or "cuts" as they are commonly called, can be made by any competent amateur photographer for use with a home printing press or for illustrating school publications or even local newspapers in towns where there is no commercial engraving plant. For example, in a small Michigan town there is a photographer who takes pictures of important local events, makes the cuts himself by the process to be described, and delivers them to the town newspaper so that they can be printed the same day. He has found it a remunerative and fascinating hobby.

A beginner cannot, of course, expect to make engravings the equal of those used for illustrating this magazine, but the quality of his work will improve with practice and be quite acceptable for ordinary printing.

**Materials.** The materials required are not expensive. Contrast plates and films are the same price as those used for ordinary snapshots and are handled by all photographic stock houses and the larger camera shops. Resins, zinc, etching ink, and similar supplies are sold by engravers' supply houses. Commercial nitric acid can be obtained at your drug store and costs less than the chemically pure grade.

**Engraving camera.** Any hand camera with a good lens and ground-glass focusing back may be used. It should preferably have a long bellows draw. A 4 by 5-in. or larger "view" camera is ideal. Even a focusing roll-film camera may be used, providing an extension box is made to fit the curve of the camera back so as to be light tight, and some arrangement is made to attach a ground glass and plate holders. The box should extend the focusing length by 4 in., and the inside should be painted dead black. (See center illustration at bottom of the facing page.)

The lens is important. A single lens is, of course, unsatisfactory. A double or

"rapid rectilinear" lens can be used, but an anastigmat is best. It need not be a "fast" lens; even those on professional engraving cameras seldom have a diaphragm aperture of more than F/11. For reasons that will be understood later, a wide-angle lens is of no use for this work because of its short focus. The focal length of the lens, as marked on the mount, should be equal to, or longer than, the diagonal distance across the plate or film opening of the camera.

**Half-tone screen.** If you examine one of the half-tone illustrations on this page with a magnifier, you will find that it is broken up into large and small dots. It was photographed through a "screen" fitted into the back of the engraving camera. You can make a satisfactory experimental screen very cheaply, or purchase a professional 4 by 5-in. screen for about \$6.

The homemade screen is prepared by drawing heavy black India ink lines diagonally across a large sheet of white cardboard. Set the ruling pen to make lines of the same width as the white spaces separating them. Make another set of equal-

ly spaced lines at right angles to the first, which will leave the white spaces as small square dots. Tack the sheet to a smooth wall for photographing on a contrast plate or film. In focusing, place the camera at the distance that will show 65 lines to the inch when measured on the ground glass with a ruler. A 65-line screen is standard for newspaper half tones. Your screen, however, can have 85 lines to the inch if the half tones are to be used on an ordinary printing press.

The screen is used to break up the photograph into dots so that the printed reproduction will have a gradation between high-lights and shadows. Ordinarily you should set the screen in the extension box so that it will be as near to the plate as possible. However, if on closing down the diaphragm you find it difficult to locate the checkerboard pattern on the ground glass, it may be necessary to move the screen forward a fraction of an inch, always remembering that it must be on the same plane as the film or plate.

The action of the screen is to provide a multitude of tiny pinhole lenses that project larger or smaller dots on the sensitive plate. The checkerboard pattern just

# ENGRAVINGS

## ORDINARY CAMERA

*An Inexpensive Way to Prepare  
"Cuts" from Photos at Home for  
Printing in Amateur Publications  
or in School Papers and Booklets*

By KENNETH MURRAY

described is the easiest for the beginner to use, and it reproduces the photograph with the greatest fidelity. After you have made a few half-tone negatives and examined them with a magnifier, this will be better understood. You can then, if you wish, try additional exposures on the same plate after giving half the exposure time with the checkerboard pattern. Opening the lens farther so that isolated black dots appear in the high-lights on the ground glass, tends to strengthen the dots in the high-lights of the finished half tone. On the other hand, another exposure can be given on the same plate so that the shadow dots will not run together, in the case of very black shadows. A smaller aperture is used and a sheet of white paper held over the copy for a fourth of the exposure time, taking into consideration that a smaller stop is being used. This is called "flashing" and tends to flatten pictures that would otherwise be too contrasty.

Before proceeding to make the screen, it is necessary to consider the type of negative required in all black-and-white engraving.

**Half-tone negatives.** These, including the one required for the screen, must be made on "extra contrast" process plates or films, and developed with the contrast formula given by the manufacturer on his instruction sheet. You will then secure negatives in which the dots are sharp and pure black, the spaces between being clear and transparent so that no further treatment is necessary.

A photograph (full size) of a half-tone cut prepared by the procedure described, and a greatly reduced reproduction of the picture from which it was made



Negatives made directly in this manner will make half-tone cuts that print the picture in reverse. Professional engravers overcome this either by using a reversing prism over the lens or by stripping the negative film from its support and reversing it. If the reversed effect is objectionable, which will not always be the case, the beginner can use a special process film that is exceedingly thin. A half-tone negative made on this can be placed with the back to the sensitized zinc in printing, thus reversing the picture. Another way, when you make your own photographs, is to reverse the negative in making the paper print. All prints should be made on glossy paper when they are to be made into half tones.

**Glass plate for half-tone screen.** The negative of the checkerboard drawing, made as previously described, should be developed in the recommended contrast developer. It must have sharp, opaque squares against clear film. It must now be printed on an albumen-sensitized sheet of plate glass. The glass, which is to form the half-tone screen, must be cut to fit inside the camera-back extension

The glass is sensitized with the follow-

ing solution, which is also used later for coating the zinc plates of the actual half tones: Beat 1 oz. fresh egg white; after it is settled add 8 oz. distilled water in which are dissolved 20 grains of ammonium bichromate and 10 drops of ammonia. Filter through cotton.

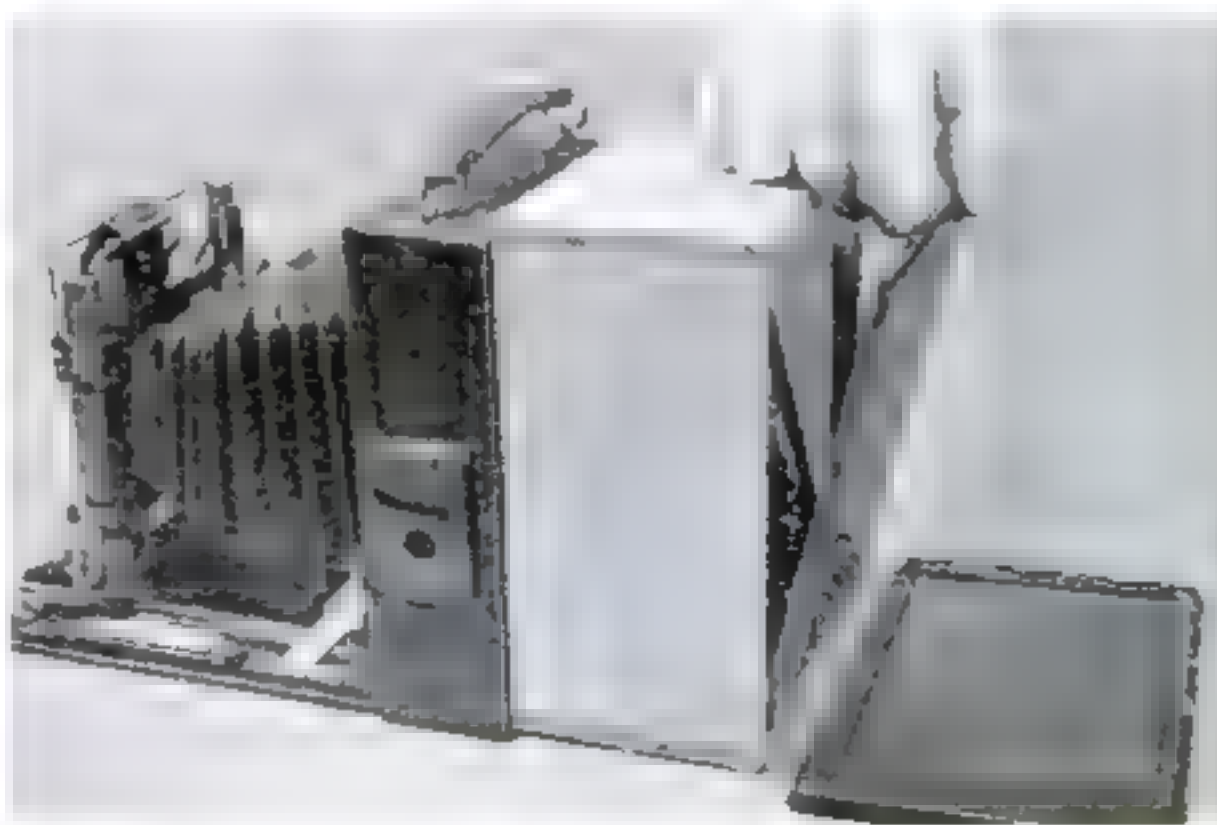
Flow the sensitizer over the cleaned glass, draining back the surplus and drying over heat as illustrated. Do not allow the glass to become hot. Handle the sensitized glass in a yellow light.

The glass is next exposed under the negative. This will require from one to two minutes with an arc light and longer with daylight. The glass can be cleaned and resensitized if the first exposure is not right.

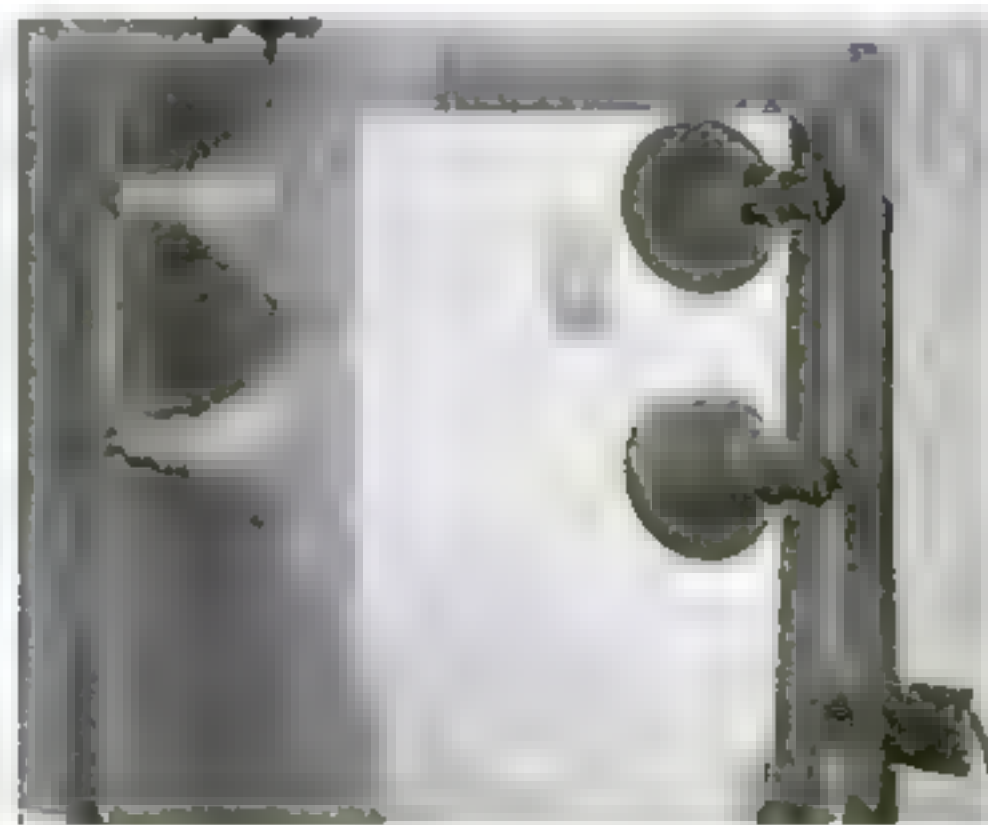
The exposed glass is now blackened with "job" printing ink and an ink roller; then allow it to soak in a tray of water for a minute. Lightly brush the surface with a wad of wet cotton, whereupon the background should wash off, leaving sharp, opaque lines such as on the original drawing. If the plate refuses to "develop," the exposure was too long; if all of the ink washes off, the exposure was too short. Shake off the (Continued on page 93)



After being exposed, the plate is coated with black ("job") printing ink and then "developed" in water



Hand camera with wooden box extension. The glass screen is fitted into the end of the box, which also has attachments for ground glass and plate holders



The copy board must be evenly and brightly illuminated. A good way to insure this is to use four photoflood lamps in reflectors

# LIGHTPROOF BOX SERVES AS *Portable Darkroom* ON CAMPING TRIPS

**M**ANY amateur and not a few professional photographers take their equipment on boating, fishing, or camping trips and often desire to develop the negatives before returning. This led the writer to construct the box illustrated. It is used for loading cut-film holders and for transferring exposed films to a daylight developing tank. In addition, it provides a safe place to keep or carry films, negatives, and cameras. For those who use roll-film cameras and daylight developing tanks, the box should work equally well in loading the tank.

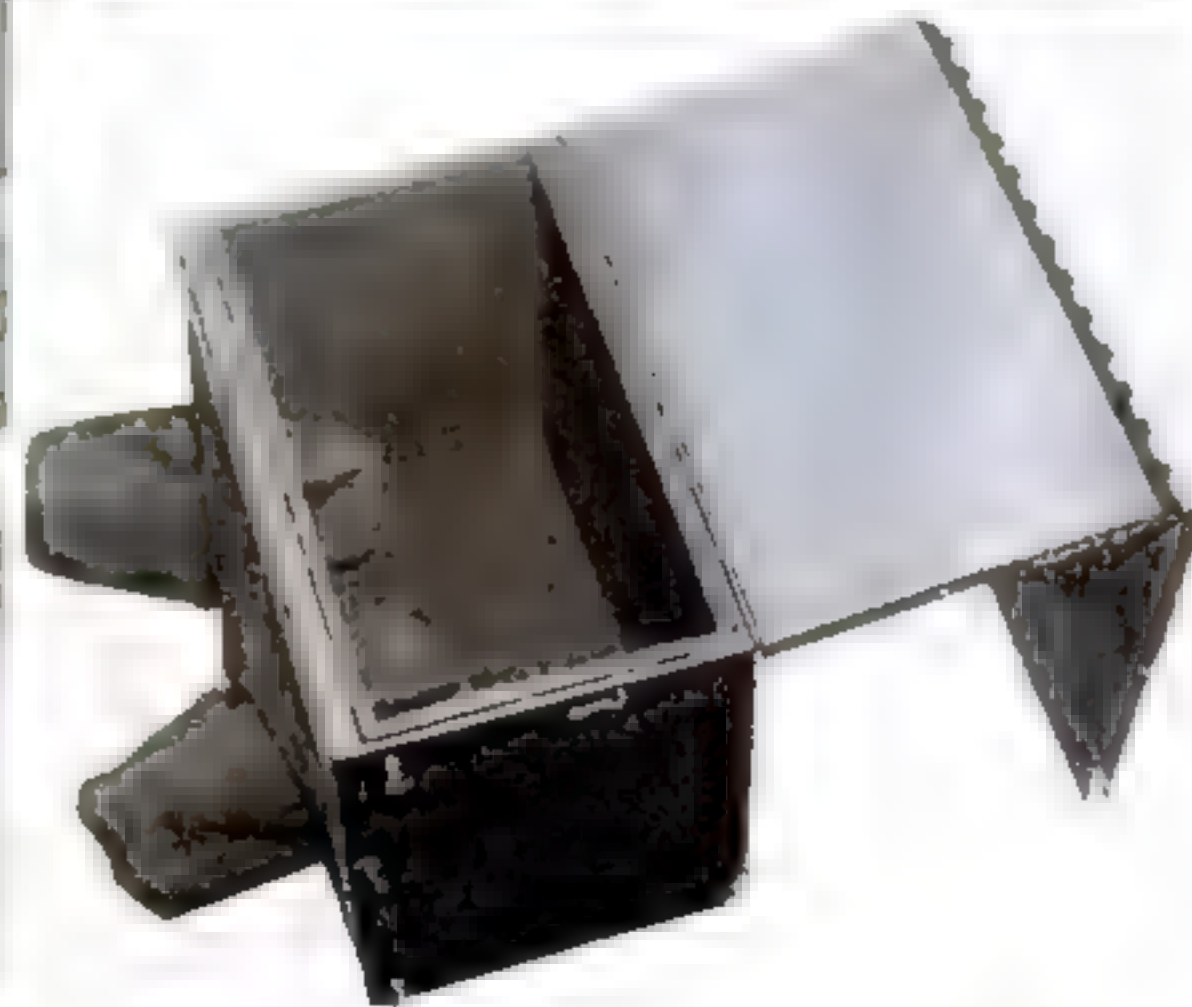
Spruce  $\frac{3}{8}$  in. thick (any light, soft wood is suitable) was fastened with screws and waterproof glue to form the box, which is 12 in. high, 10 in. deep, and 16 in. long, inside dimensions. This gave the right amount of space for a 9 by 12-centimeter outfit. A roll-film outfit would not require so large a box.

The crosspiece above the apron was made of  $1\frac{1}{4}$ -in. square oak. The two long cover hinges were taken from old battery radio sets. The rubber apron was made by cementing black sateen cloth to one side of brown rubberized cloth with rubber cement. The double sleeves were made up separately with elastic at one end of each, then sewed and cemented in the apron front, which is the same material. The rubber surface should be on the inside of

The box is shown at the right with the cover open to illustrate the method of manipulating films. The other photos show its general construction and how it looks when closed

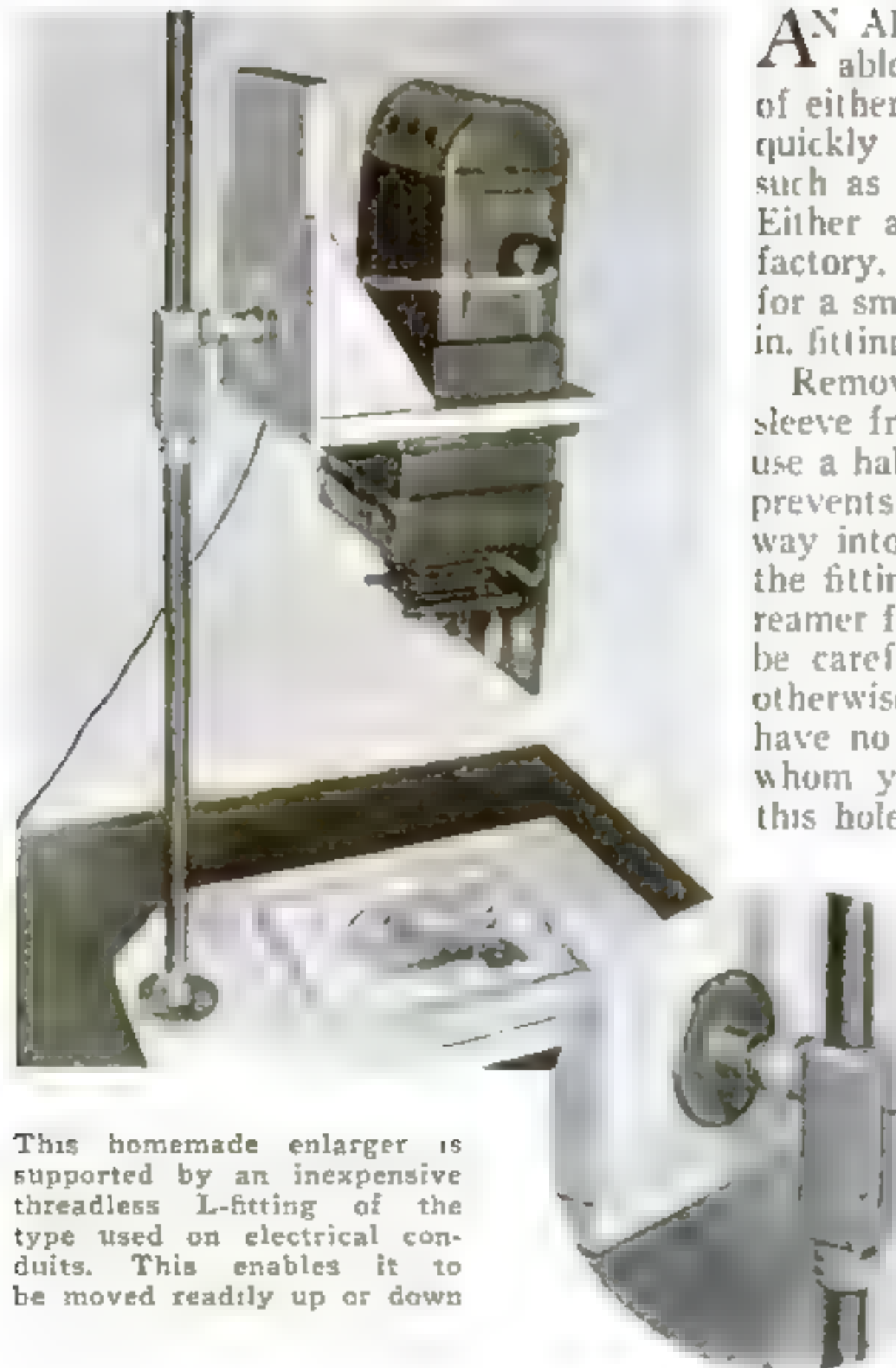


the box to facilitate wiping out the dust. To make the box water-tight, dustproof, and light-tight, a strip of sponge rubber (such as used around car doors) was cemented in a shallow rabbet around the



top and front of the box so that about three fourths of its thickness projected above the wood when the covers were open. When closed, the rubber is compressed, forming a seal.—ELTON C. CLINE.

## SLIDING BRACKET FOR AN ENLARGER



This homemade enlarger is supported by an inexpensive threadless L-fitting of the type used on electrical conduits. This enables it to be moved readily up or down

**A**N ADJUSTABLE sliding bracket suitable for a homemade photo enlarger of either vertical or horizontal type can be quickly made from a threadless L-fitting such as is used in electrical conduit work. Either an LR, LB, or LL type is satisfactory. A  $\frac{1}{2}$ -in. fitting is sufficiently rigid for a small enlarger, but a  $\frac{3}{4}$ - on even a 1-in. fitting should be used for heavier outfits.

Remove the threaded collar and tapered sleeve from the long arm of the fitting and use a half-round file to remove the lip that prevents the conduit from sliding all the way into the fitting. The opposite end of the fitting is then reamed out with a pipe reamer for the conduit to pass through, but be careful not to get this hole too large, otherwise the bracket will be shaky. If you have no pipe reamer, the electrician from whom you obtained the fitting can ream this hole for you in a few minutes.

The shorter arm of the L is fitted with a close nipple and floor flange as shown, and the collar is tightened with a wrench. The other collar on the sliding bar is left loose and in use is tightened or loosened by a twist of the wrist. This alone is sufficient to hold the enlarger securely in position.—IRVING WEINER.



## PRINTING FRAMES HOLD ENLARGING PAPER

OWNERS of homemade horizontal enlargers who are exasperated by the problem of providing a paper holder that will give a clean-cut, uniform margin can easily construct a device like the one illustrated above.

A small drawing board (or other board of suitable size) is attached vertically to a wooden base by means of angle brackets. The paper holders consist of regular printing frames, of the sizes most needed, suspended at the correct position on the board by hooks and screw eyes. The eyes should be fastened so that the frames, when in position, will lie firmly against the board.

The image is composed and focused on a sheet of ordinary white paper held in the frame. The enlarging paper is then inserted and the frame rehung.—K.M.S.

## FAST ACTION



## INDOORS AT NIGHT



## EVEN IN THE RAIN



Much less than actual size

# For the pictures you want —when you want them

**T**HE big fun of picture making is in having a camera that doesn't need time off. Kodak Six-16 (f.4.5) lets you master every snapshot opportunity.

Every hour of the day or night is picture-making time with this modern Kodak. No matter when or where snapshot opportunities arise, you're set with Kodak Six-16.

Action shots . . . scenes . . . close-ups . . . even indoor snapshots at night, with Kodak "SS" Film and Mazda Photoflood bulbs, are easily within range of this Kodak. Take the restrictions off your snapshot making . . . ask your dealer to show you this all-round, fine Kodak.

**FEATURES:** 1/400-second Compur-Rapid shutter with delayed-action timer, Kodak Anastigmat f.4.5 lens, eye-level finder. Makes 2½x4¼-inch pictures, costs \$40.

**Kodak  
Six-16  
(f.4.5)**



The 4-section lens is a photographic jewel . . . a high-quality, high-speed anastigmat that "makes good" under difficult conditions.

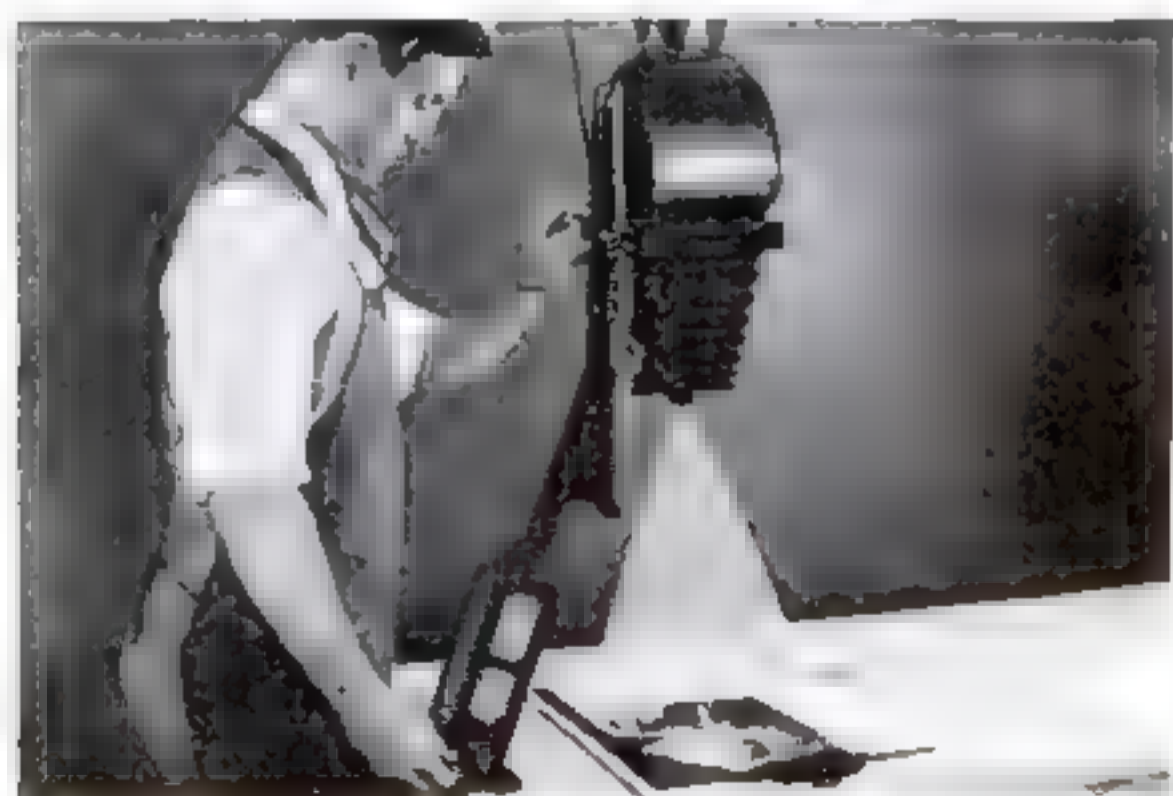


The Compur-Rapid shutter has nine speeds, from 1 to 1/400 second. Has delayed-action timer so that you can get in the picture yourself.

The eye-level finder frames the picture accurately when following fast action. When not in use it folds flat against side of camera.



Metal spools make the Kodak Six-16 the smallest roll-film camera for its picture size. No bulky wooden spools to take up valuable room.



**KODAK AUTO-FOCUS ENLARGER, MODEL B**—The ideal enlarger for home darkroom—takes negatives up to 4x6 inches, is adaptable to film or plate negatives, enlarges from 1½ to 3½ diameters. Complete with lens, Photoflood lamp, paper holder, table clamp and set of seven flexible metal masks. Price, \$40.



## KODAK CATALOG

Write today for your copy of the small Kodak catalog, 1936 edition, or get it at your dealer's . . . Eastman Kodak Company, Rochester, N. Y.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

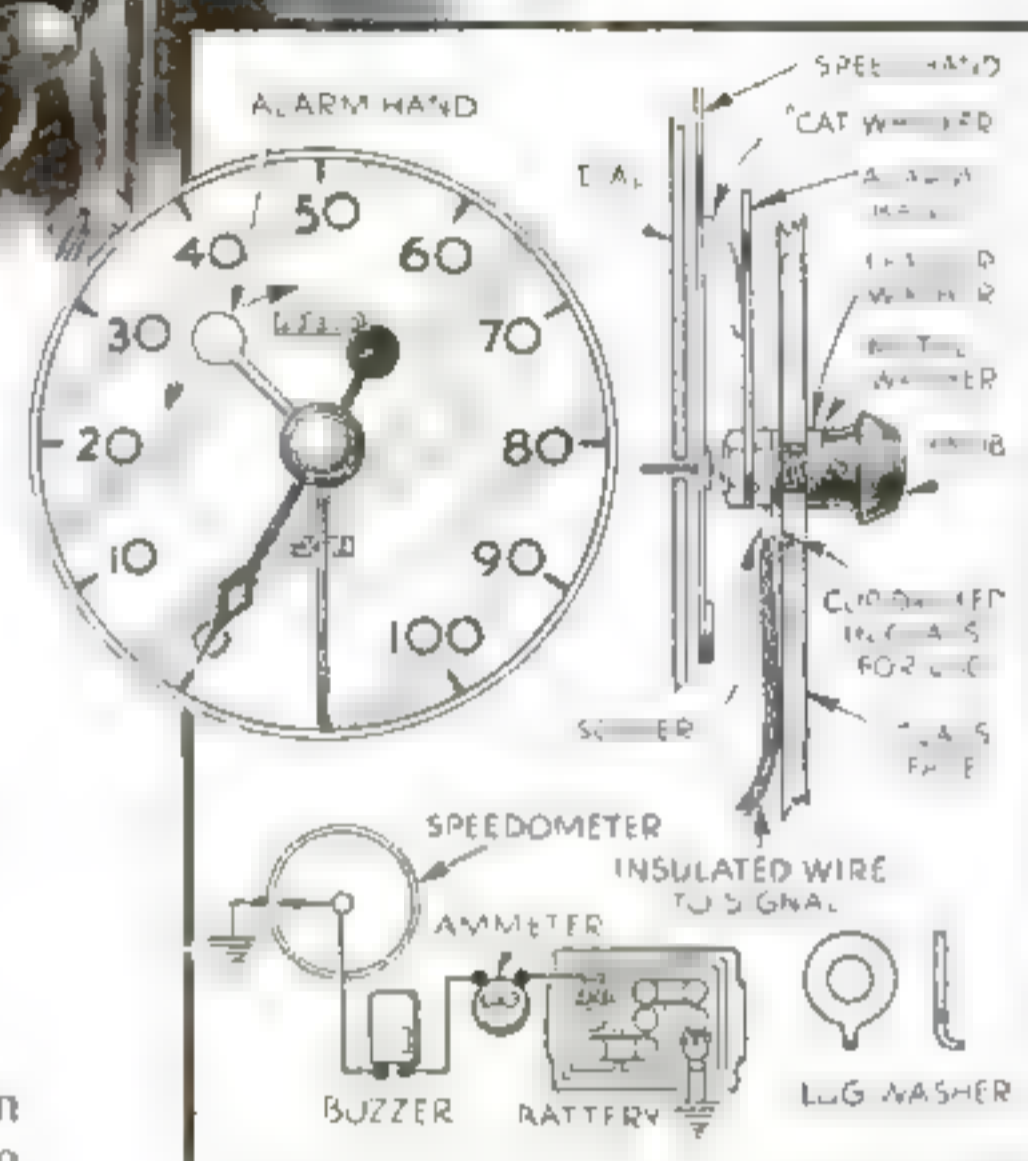
P. S. 9-38

# Timely Aids for Autoists

*Motor-Wise Readers Pass Along  
These Helpful Suggestions for  
Car Maintenance and Repairs*

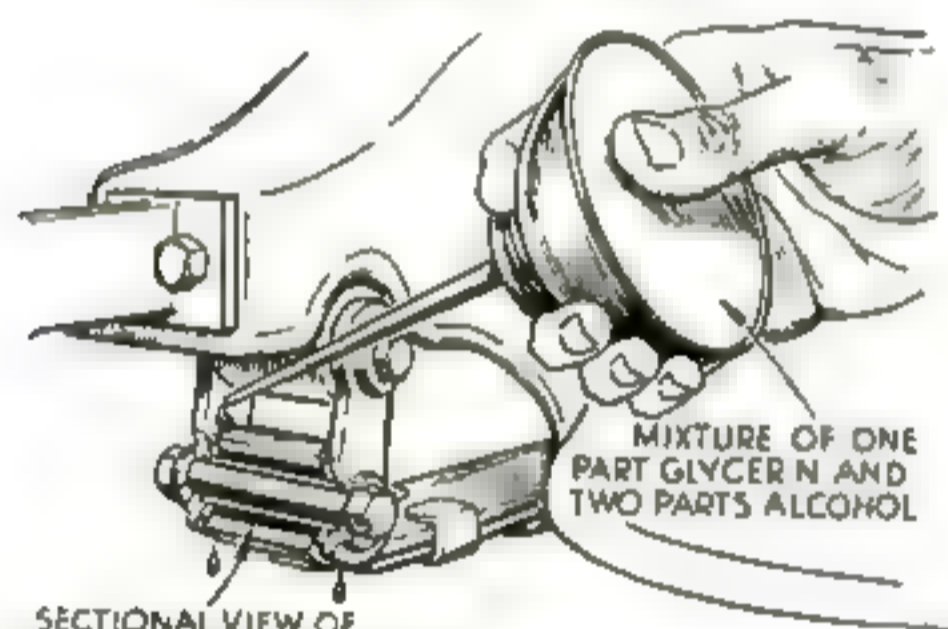
**BY ALTERING** the speedometer slightly, you can provide your car with a novel speed alarm that will warn you the moment you exceed the speed for which it is set. As shown in the illustration, it consists simply of a movable needle or hand provided with a "cat whisker" and mounted in such a way that the speedometer needle on passing it makes contact and completes an electrical circuit to a buzzer. A knob conveniently located on the speedometer glass makes it an easy matter to adjust the alarm hand to any speed

desired. On tours, the alarm hand can be set at the speed indicated by the signposts along the road. Then, if you exceed the speed limit, the sound of the buzzer will warn you. As indicated in the diagram, one wire leading to the "cat-whisker" arm is the only electrical connection required; the metal speedometer cable providing the return lead or ground. The speed alarm is a big help when driving a newly overhauled car.—H H R



The drawing shows how to put a speed alarm on any ordinary airplane-type speedometer

## Homemade Solution "Oils" Rubber Shackles



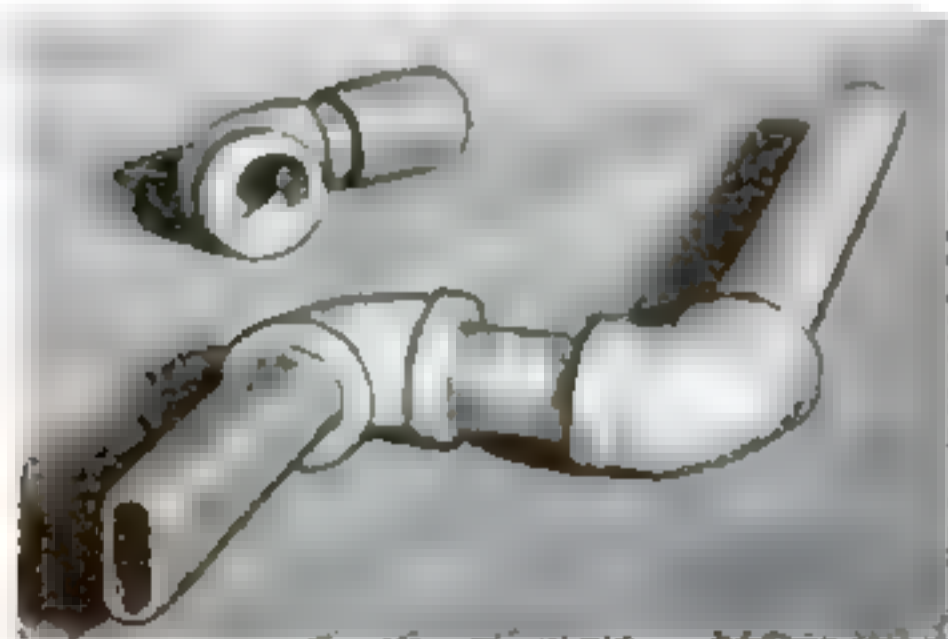
SECTIONAL VIEW OF RUBBER-BUSHED SHACKLE

Glycerin and alcohol make a lubricating mixture that will not cause rubber parts to rot

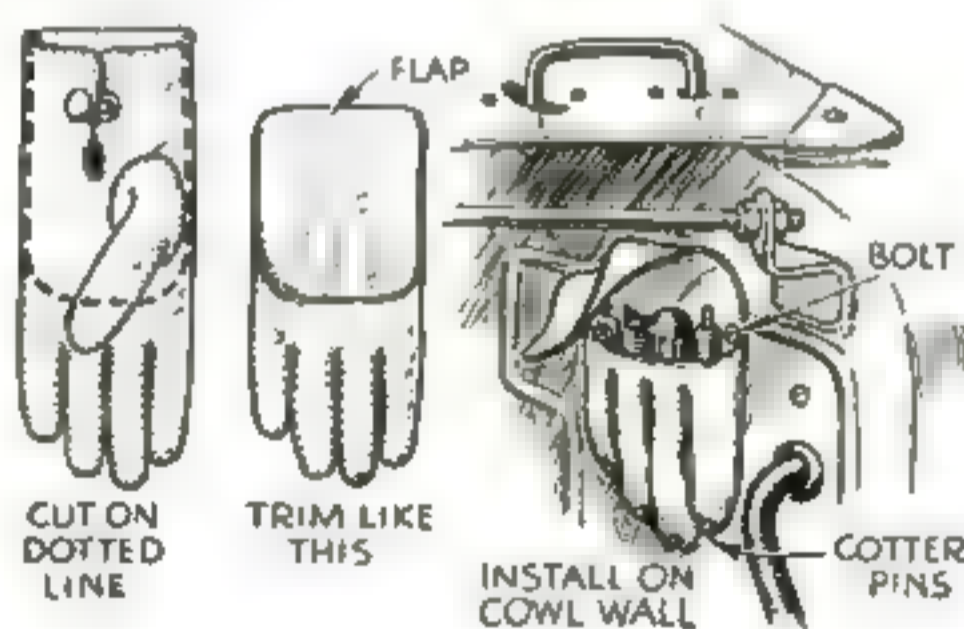
SINCE oil has a deteriorating effect on rubber, it is difficult to know just how to lubricate rubber shackles when they develop squeaks. About the best lubricant I've found consists of a mixture of alcohol and glycerin made up in the proportions of two parts to one. The alcohol, acting as a vehicle for the glycerin which is the lubricating agent, evaporates, leaving a protective covering on the rubber. The solution can be applied to the shackles easily with an ordinary oil can. An added feature of this lubricant is that it is inexpensive to make up.—C. W.

## Handy Wrench Extension Made From Old Pipe

A HANDY wrench extension for getting at nuts and bolts in out-of-the-way places can be made from scrap sections of pipe and old pipe fittings. It consists of two L's, one nipple, one coupler, one length (eight to eighteen inches), and one short section flattened to an oval shape at the end. This flattened piece serves as the socket or holder for the handle of the wrench. With the extension, a wrench can be used in close quarters.—J. M. V.



The wrench handle is slipped into the flattened end of this pipe to reach tight places



## Uses Old Leather Gloves As Holders for Tools

HERE is a handy way to store spare spark plugs, extra lamp bulbs, and tools. Simply cut the front wrist section and thumb away from an old leather glove and bolt the glove to the front of the metal motor-cowl panel as shown. The fingers of the glove take the spark plugs or tools, while the remaining wrist portion serves as a flap. Being mounted under the hood, the parts and tools always will be handy and dry when needed. If desired, the ends of the fingers can be fastened to the cowl with cotter pins.—A. H. W.

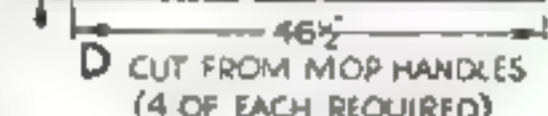
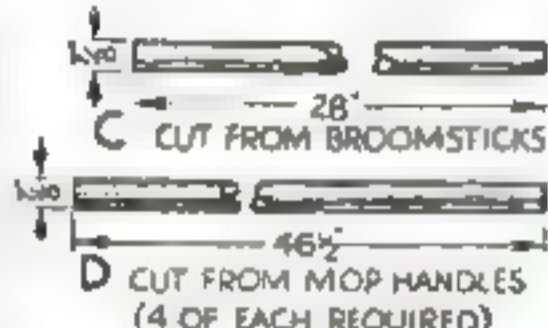
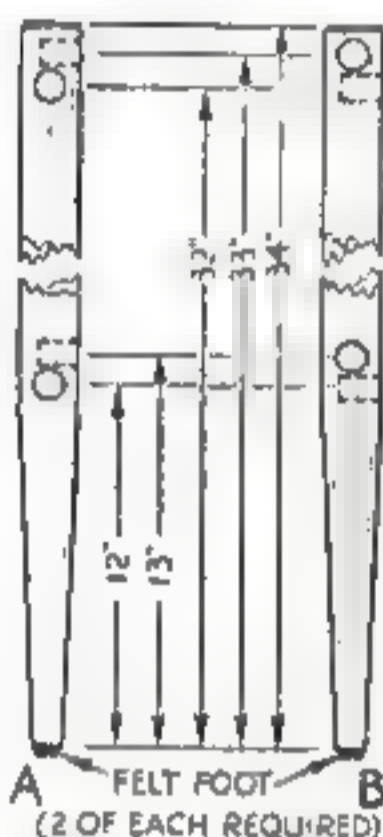
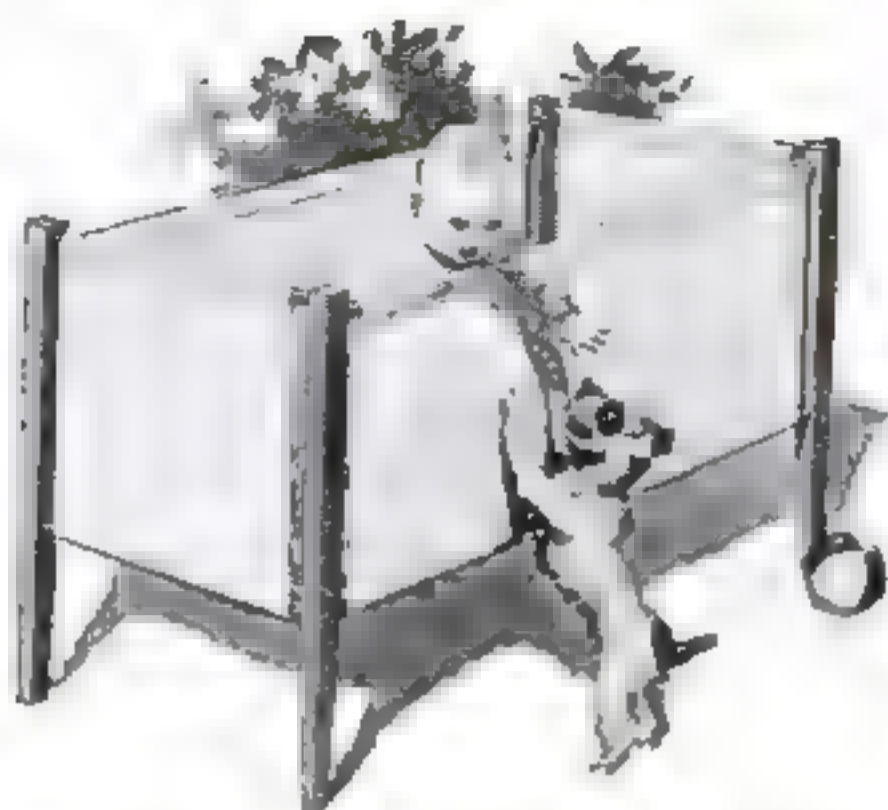


Tapping the bottom of the hinge pin with a hammer forces the oil to all parts of the pin

## Easy Way To Silence Squeaky Door Hinges

AN OIL can filled with penetrating oil and a hammer are the only tools you need to eliminate the most stubborn door-hinge squeak. First soak the hinge with the oil. Then, when the hinge parts are well covered, tap the bottom end of the hinge pin with the hammer. This will force the oil around the pin where dry friction generally causes the squeak. The tapping causes the oil to work itself over the whole surface of the hinge pin.—W. C. F.

## FOLDING CRIB FOR USE ON TRIPS FROM HOME



WHEN traveling, camping, or visiting, you can provide sleeping accommodations for a baby or a child up to four years old by making a portable crib like that illustrated.

Four legs of 2 by 2-in. pine are shaped and bored with  $\frac{7}{8}$ -in. holes as at A and B, and eight round rails prepared as at C and D. Two pieces of extra heavy unbleached sheeting, one approximately  $25\frac{1}{2}$  by 94 in. and the other about 44 by  $75\frac{1}{2}$  in., are cut from  $2\frac{2}{3}$  yd. of 72-in. material and strongly sewn with a wide hem at each end. A bag of strong black drill is made to contain the framework while traveling.

To assemble the crib, stand two of the legs (one A and one B) against the wall with the uppermost holes facing toward you and the lower holes facing each other. Thread one of the short members through the hem on one end of the narrow piece of sheeting and place this member in the inner top holes in the legs. Next place the four long members in the holes in the four legs. Thread another short member through the opposite hem in the sheeting and fit this in the two top holes in the legs away from the wall. The other two short members are then placed in the holes drilled for them in the legs and inside the sheeting. The last of these members should be sprung into place. One of the upper long members is then removed, threaded through a hem in the wider sheeting, and replaced. The sheeting is passed under the rest of the assembly, and the remaining upper long member is removed, threaded through the hem, and sprung back into place. A folded blanket should be laid across the bottom of the crib for additional warmth.—FREDERICK W. MOTTON.



To put up the crib takes only a few minutes

# GUILTY?



## DON'T GAMBLE! GET THE ONLY TIRE WITH GOLDEN PLY BLOW-OUT PROTECTION!

**Driver:** "What a fool I was to try to squeeze a few more miles out of these tires. They won't find me guilty of gambling on blow-outs from now on."

Are your tires safe? Do you realize what havoc one blow-out can play with life, limb, car, and pocketbook? You be the judge and jury. Decide now whether it isn't better to be safe than sorry—whether real blow-out protection isn't a better investment than trying to squeeze a few hundred more miles out of tires that might blow out.

### Why tires blow out

You know that 40—50—60 miles an hour is nothing for today's cars. But do you know that these high speeds generate terrific heat inside the tire? That's exactly what happens. Then rubber and fabric begin to separate. A blister forms. You can't see it. You speed on. And all the time this invisible menace to your life is growing Bigger and BIGGER until, sooner or later, BANG! A blow-out! And after you've recovered from the shock the first thing you're likely to say is "no more tire gambling for me."

Don't wait to see how serious and costly a blow-out can be before you equip your car with Goodrich Safety Silvertown Tires. Because Silvertowns have something that no other tire in the world has—the Life-Saver Golden Ply—a layer of special rubber and full-floating cords,

scientifically treated to resist internal tire heat. By resisting this heat, the amazing Golden Ply keeps rubber and fabric from separating. It keeps blisters from forming. And when you prevent the blister, you prevent the high-speed blow-out.

Remember, safe motoring depends on safe tires. So see your Goodrich dealer about a set of Silvertowns. They cost much less than other super-quality tires and they may save your life!

HEAT CAUSES BLOW-OUTS.  
PREVENT THOSE  
BLOW-OUTS WITH THIS  
HEAT-RESISTING  
GOLDEN PLY



**FREE!** Prove that you want to prevent accidents. Go to your Goodrich dealer. Join the Silvertown Safety League—sign the Goodrich Safe Driving Pledge. As a mark of distinction your Goodrich dealer will get for you absolutely free a Safety League Emblem with red crystal reflector to protect you if your tail light goes out.



*The new* **Goodrich SAFETY Silvertown**  
With Life-Saver Golden Ply Blow-Out Protection



#### BUBBLE PICTURES SHOW WHY!

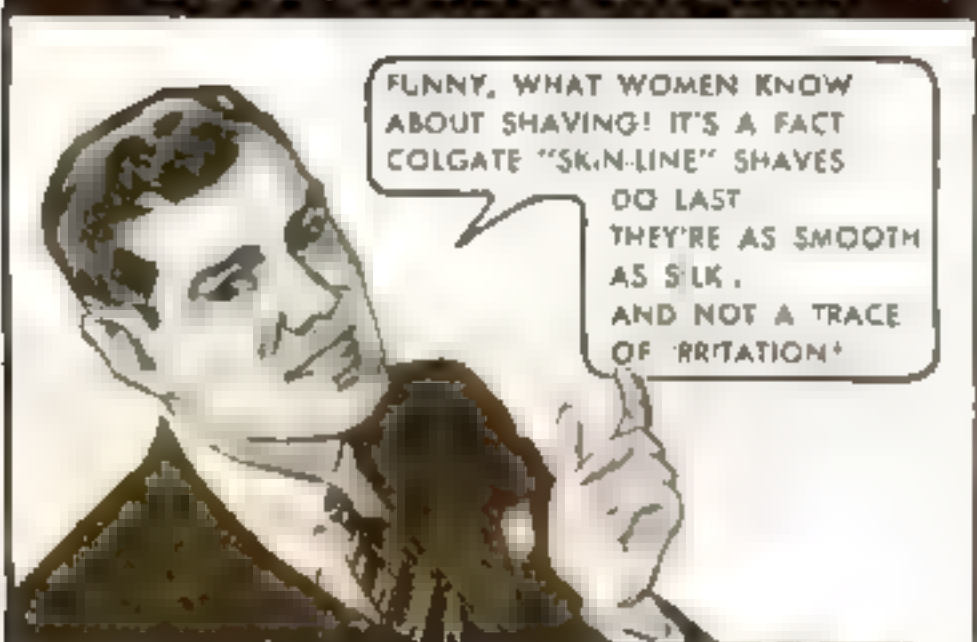


**MOST LATHERS** are made of bubbles too big to get to the base of the beard! Air pockets keep the soap film from reaching the whiskers. So the beard is only half-wilted.



**COLGATE RAPID-SHAVE CREAM** makes tiny bubbles that get clear down to the skin-line. Its rich soap film soaks your beard soft at the base. Makes your shaves last longer.

#### ONE WEEK LATER!



**COLGATE "SKIN-LINE"** SHAVES LAST HOURS LONGER



Craftwork exhibition of the Galesburg (Ill.) Homeworkshop Club, held in a local store

## GUILD CLUBS

*Show Unusual Summer Spurt*

**A** WIDE variety of activities among clubs affiliated with the National Homeworkshop Guild is shown by recent reports from club secretaries. A number of groups have held unusually successful exhibitions, while others are busy making all kinds of craftwork projects to be displayed at fall and winter shows. Although Christmas is many months away, several clubs have started constructing toys to be distributed to needy children during the holidays.

**Cheyenne (Wyo.) Homeworkshop Club.** The annual exhibit, which lasted for six days, attracted an attendance of 1,082. In the senior group, prizes were awarded as follows: first, Joseph Gaukel, for a cedar chest; second, W. C. Schlosser, alabaster lighthouse; third, P. V. O'Kelly, display of handmade, hand-painted birds in natural surroundings. Junior group: first, Robert McMullen, pair of book ends with a design, "Frontier Days"; second, Joseph Tipton, inlaid checkerboard; third, Ray Rorabaugh, metal desk lamp. First prize for the best collection in the junior group went to Gerald Wadleigh and second to Byron Hacker. The club held its annual banquet the final night of the show, and fifteen members of the Denver Homeworkshop Club traveled 208 miles to attend. Edward L. Kopp, Jr., secretary of the Cheyenne club, acted as toastmaster.

**Fairmont (W. Va.) Homeworkshop Club.** Several thousand persons viewed the club's first hobby show, which was held in the windows of a local hardware store. Although scheduled for only one week, the show attracted so much attention that it was extended for a second week.

**Coulee Dam (Wash.) Homeworkshop Club.** Composed entirely of government employees of the U. S. Bureau of Reclamation, which is building the Grand Coulee Dam on the Columbia River, all the members of this club have home workshops and are actively turning out furniture and other articles.



Official Magazine  
POPULAR SCIENCE  
MONTHLY

**A. F. Darland**, chief field engineer for the government, is building a large oak dining table and chairs of original design. **C. E. Benjamin**, inspector of building construction, is making an accurate scale model of the dam and power plant, together with shiftable sections of

overlay representing the original ground line before any excavation. **O. I. Craft** is building a set of dining room chairs. **Wendell T. Mulkey** has constructed his own lathe, band saw, and many of his hand tools. The officers are **Ross K. Tiffany Jr.**, president; **E. Robert Hogan**, vice president; **P. R. Nalder**, secretary.

**Los Angeles (Calif.) Union Railroad.** The club has assumed the name of its model railway, which is located in Pasadena and has over 200 track feet of 1¼-in. railroad, built to the scale of ¼ in. equals 1 ft. Each member has a particular job to perform as follows: **M. W. Barker**, general manager; **W. A. Cooper**, general superintendent; **W. S. Hofford**, assistant to general manager; **K. A. Wald**, treasurer; **L. D. Cameron**, chief engineer; **H. Musgrave**, signal engineer; **E. H. Schoepfer**, signal supervisor; **W. F. Drain**, yardmaster; **C. A. Reisinger**, construction engineer. There are also towermen, operators, section foremen, etc.

**Minneapolis (Minn.) Homeworkshop Club.** **Ray Jensen** was reelected president at the annual meeting.



**Everett Barton**, secretary of the Berkshire Homeworkshop Club of North Adams, Mass., working on his model of the *Great Republic*

nual meeting; Dan J. Sullivan is the new vice president; L. E. Burgan was reelected secretary-treasurer. Mr. Jensen is chairman of the cabinet making division and Mr. Sullivan of the ship model division. A luncheon and party closed the season, and no further meetings will be held until October.

**Fair Oaks (Pa.) Home Shop Club.** There are ten charter members. Fred Bauer, Jr., is president; G. E. Chesler, vice president; Lester Neeley, secretary; Fred Bauer, Sr., treasurer.

**Chickasaw Homeworkshop Club, Memphis, Tenn.** Plans are under way for the second annual exhibit and demonstration to be held in conjunction with the Mid-South Fair. . . . At a recent meeting Guy Parks gave a demonstration and talk on upholstering.

**Sterling Hobby Guild, New York City.** Meetings have been suspended for the summer, but an ambitious program is planned for the fall including a membership drive, a series of at least twelve lectures by specialists, trimonthly showings of moving pictures dealing with scientific subjects, construction of a workbench and furniture for club, a competition for selecting a club emblem, publication of a monthly bulletin, the obtaining of suitable headquarters, and the beginning of classes in woodworking, photography, radio, basket making, and stamp collecting.

**Mansfield (Mo.) Homeworkshop Club.** Officers are W. M. Young, president; C. W. Faust, vice president; R. D. Harris, secretary; David Benjamin, treasurer.

**Norfolk (Va.) Homeworkshop Club.** There are fourteen charter members in this new club. L. M. Khnefelter is president; C. J. Christensen, vice president; A. E. Jakeman, secretary-treasurer.

**Woodworkers Group of Philadelphia (Pa.).** The club held its first hobby show recently and as a result was able to increase its membership considerably. Officers are William Doyle, president; Clifford E. Cunningham, secretary; R. D. Johns, treasurer.

**Capital Homcraft Club, Washington, D. C.** George A. Simonds has been appointed chairman of the committee to arrange for the club's second annual exhibit in the fall. Subcommittees are as follows: H. E. Middleton, location; Orrin Davy, publicity; J. Chlopicki, E. W. Parks, assembling of exhibits; Lewis E. Johnson, arrangement of exhibits; Ellsworth D. Jones, W. D. Lawlor, William B. Crowell, selection of judges; David Porterfield, solicitation of prizes. . . . The club holds its business meeting on the second floor at 610 Ninth Street, N. W., on the first Tuesday of each month, and members of the National Guild visiting in Washington are invited to attend.

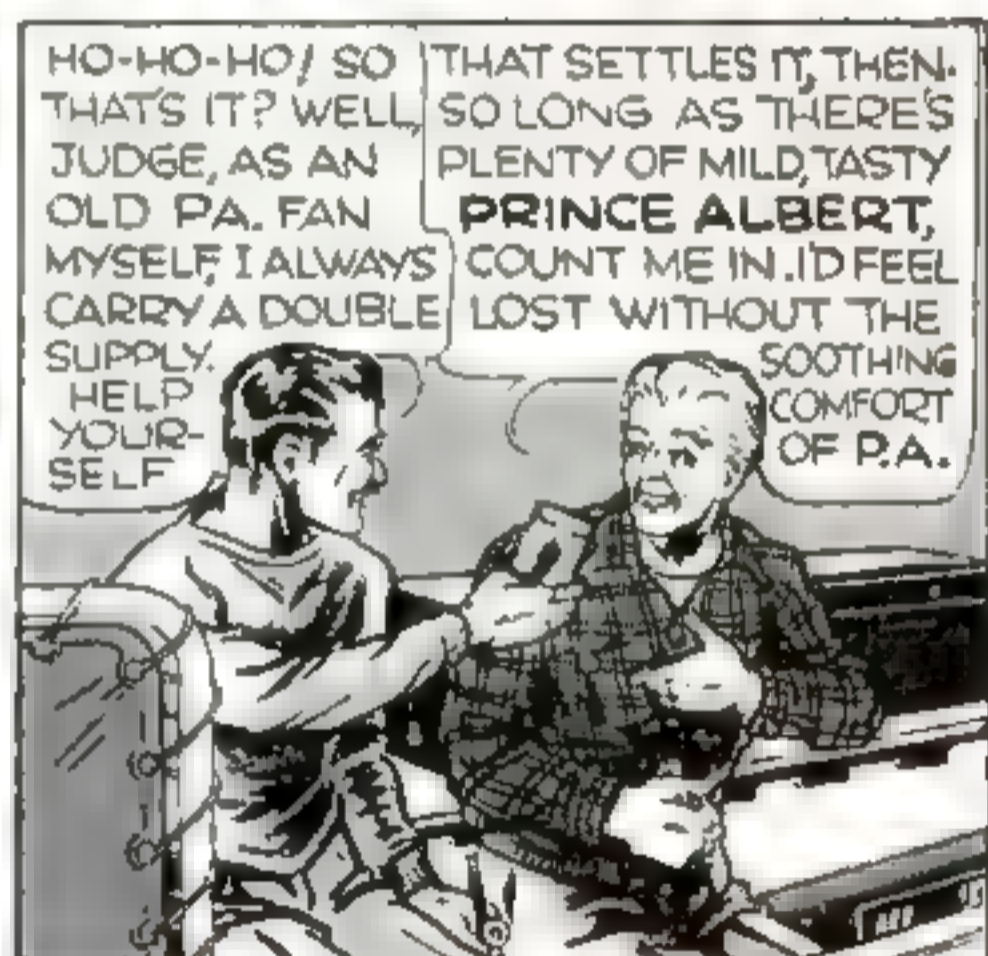
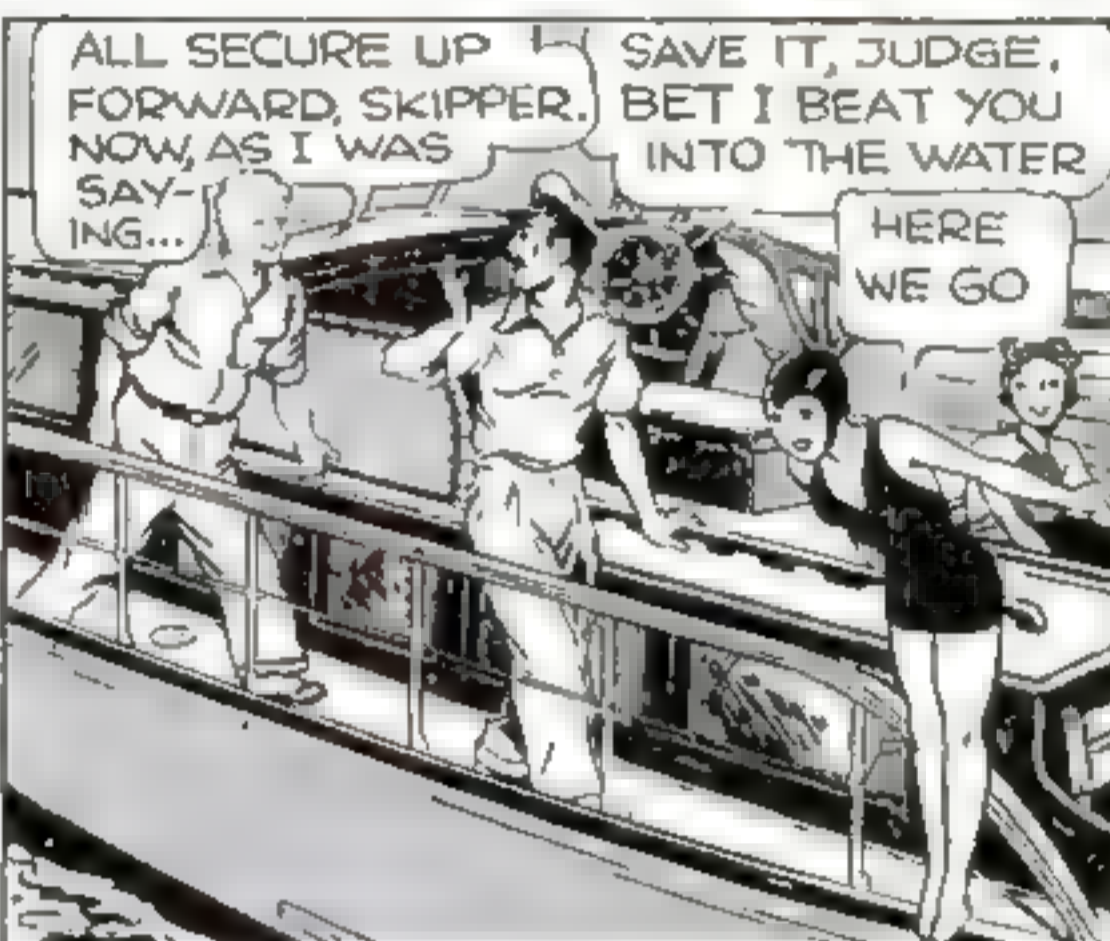
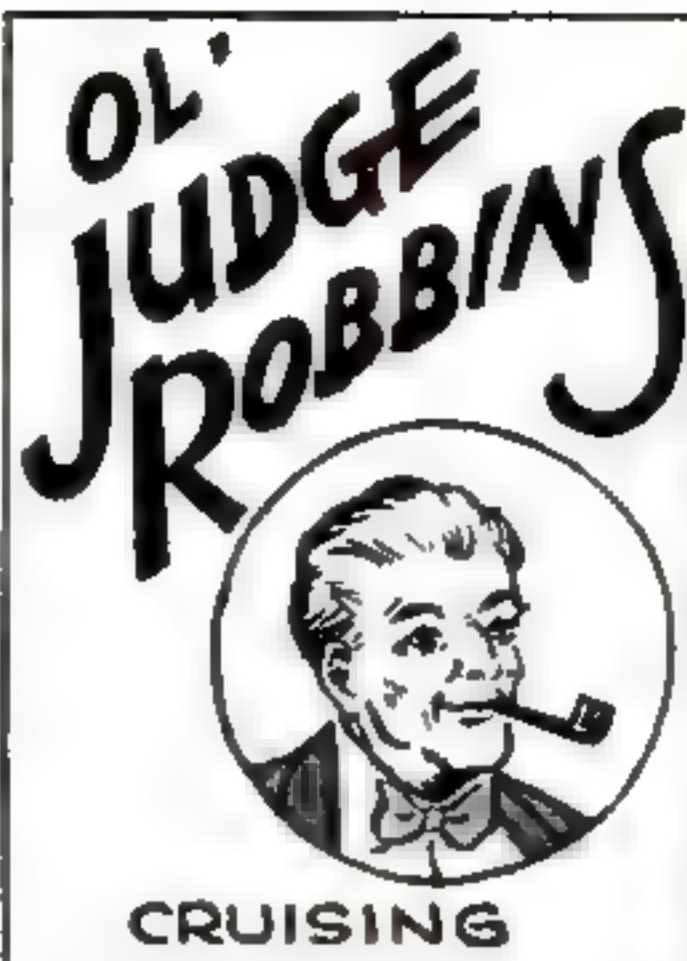
**Col. William H. Waldron Homeworkshop Guild, Missouri Branch, W. Va.** CCC Company 3540, S-71, recently formed this club and elected Capt. Franklin W. Patten as president; Frank Harrison, vice president; Wilford H. Rutherford, secretary; First Lieutenant M. M. Brown, treasurer.

**Fall River (Mass.) Homcraft Club.** Albert Boutin has been placed in charge of a blueprint exchange service as he has approximately 100 plans which may be borrowed by members.

**Cartier Homeworkshop Club, Montreal, Canada.** Members are working on three model locomotives, the plans of which were made by Paul Denis, secretary. Several also are constructing models of the *Queen Mary* and a harbor tugboat and its barge, which were described recently in *POPULAR SCIENCE MONTHLY*.

**Winfield (Kan.) Homeworkshop Club.** Organized recently, the club has elected the following officers: Harold S. Wortman, president; Oscar A. Zimmerman, vice president; Arthur J. Gifford, secretary; Ross Wilkins, treasurer. On the membership committee are Wilkins and Zimmerman; program, John A. Gesler, Gerald Tharp, and Joseph N. Wade.

**Garden City Homeworkshop Club, San Jose, Calif.** The (Continued on page 84)



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## 50 PIPEFULS OF SMOKING JOY!



There's good reason why Prince Albert is the world's largest-selling smoking tobacco. P. A. is the "crimp cut" smoke... packs easier in your pipe, cakes nicely, burns cooler. P. A. is prime tobacco too—every last particle of it. Smokes sweet, mild, and tasty. Doesn't bite the tongue. So get in on Prince Albert—the princely tobacco for pipes and roll-your-own cigarettes too. See our money-back offer below.



### PRINCE ALBERT GUARANTEES SATISFACTION

Smoke 20 fragrant pipefuls of Prince Albert. If you don't find it the mellowest, tastiest pipe tobacco you ever smoked, return the pocket tin with the rest of the tobacco in it to us at any time within a month from this date, and we will refund full purchase price, plus postage. (Signed) R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

**PRINCE ALBERT** THE NATIONAL JOY SMOKE!

50 pipefuls of fragrant tobacco in every 2-ounce tin of Prince Albert

I WANT  
COLORS TO  
MAKE THE HOUSE  
LOOK NEW AND  
DIFFERENT

THEN BE  
SURE OF THE  
color  
scheme  
BEFORE YOU  
PAINT



SEE THE PICTORIAL COLOR CHART

If you would enjoy seeing a display of fascinatingly different color schemes which will bring a new attractiveness to your home, be sure to visit your nearby dealer in Lowe Brothers painting and decorating materials.

He will gladly show you the Lowe Brothers Pictorial Color Chart. You will see rich, invigorating exteriors and charming interiors—all reproduced in *actual paint*. You will find it interesting and easy to choose a color combination which will make your house look new and different.

What's more, you can depend upon the known quality of Lowe Brothers paints, which contain approximately 90% film-forming solids, as against many "cheap" paints, which often contain as little as 37% film-forming solids—the rest being water and other evaporating liquids.

Don't take any chances. Depend upon Lowe Brothers quality to insure maximum economy and enduring beauty. The Lowe Brothers Co., Dayton, Ohio.

★  
Free: Illustrated book containing color schemes and helpful suggestions. Ask your dealer.

**Lowe Brothers**

PAINTS • VARNISHES  
Quality Unsurpassed Since 1869

## NATIONAL HOMEWORKSHOP GUILD CLUBS

(Continued from page 83)

officers of this new club are A. F. Fortier, president; James Wilson, vice president; Jack Bergevin, secretary; John Kelly, treasurer.

**The Toledo (Ohio) Homecrafters.** A membership drive is being conducted. Officers for the year are E. C. Rohrbacker, president; Carl F. Hawkins, secretary; G. F. Travis, treasurer. The board of governors consists of Julius Raab, Paul Lambert, and Chester Snare. George M. McLeary is in charge of entertainment.

**Philadelphia (Pa.) Homecrafters Guild.** Officers for the year are D. R. Rutter, president; J. W. Snyder, secretary; G. A. McHugh,

ized this club and elected W. E. McLeod president; H. Hutchinson, vice president; D. Fraser, secretary-treasurer.

**Sunset Social and Hobby Club, Brooklyn, N. Y.** Officers are James Arnish, president; Edward Korsberg, secretary; Charles Ward, treasurer.

**Lambert's Homecraft Boat and Mariners Association, Chicago, Ill.** A dinner dance was held aboard the club's ship *Sea Dog* before discontinuing meetings for the summer. . . . At a recent meeting at the home of President A. M. Majewski, plans were made for a two weeks' camping tour. . . . A junior auxiliary has been started under the sponsorship of the secretary, Capt. R. D. Lambert.

**Saginaw (Mich.) Homecraft Club.** Members have started constructing toys to be given to the Salvation Army for distribution at Christmas. Meetings are being continued through the summer, and the club hopes to double its membership by fall.

**Kenosha (Wisc.) Homeworkshop Club.** Officers are S. L. Severance, president; H. A. Link, vice president; W. W. Daniel, secretary; Fred Bullock, treasurer. There are seventeen charter members.

**Cedar Rapids (Iowa) Homecrafters Guild.** Milton Towner, retired manual training teacher, exhibited examples of chip carving and laminated work, some pieces being from twenty-five to fifty years old. R. L. Whelan displayed walnut silhouettes used as wall pieces. It was decided to discontinue business meetings during the summer, but to have informal sessions at members' shops in order to continue the Christmas project of making toys.

**Columbia Homeworkshop Club, Paterson, N. J.** The members have been making their own saw tables. A competition is being planned in which the member turning out the best and most original article will receive a prize.

**Lackawanna Homeworkshop Club, Pen-ticton, B. C., Canada.** Among the projects being made by members are a music cabinet, model of the clipper ship *Sea Witch*, midget racer and motor boat, garden cultivator, hunting knife, power saw, kitchen cupboard, table lamp, and examples of taxidermy. . . . F. Suckling is club photographer.

**Miami (Fla.) Homecraft Guild.** H. F. Loomis was awarded first prize of a band saw in the first annual contest. Other winners and awards follow: A. E. Deville, circle saw; J. M. Elliott, shaper; W. J. Haughey, wood carving set; Harry E. Cooper, artist's kit; George W. Kosel, cans of paint; R. L. Bray, hammer. Prizes were donated by local hardware stores and the judges included J. I. Sowers, director of industrial arts in the Miami public schools; C. H. Rice, director of industrial arts, Homestead High School, and Charles Roman, superintendent of a local furniture factory. . . . The following officers were reelected recently: James M. Elliott, president; Seymour Brandes, first vice president; Will Smith, secretary, and Royce Chalmers, treasurer. H. F. Loomis was elected second vice president and F. A. Brown, librarian. E. L. Day spoke on inlay work.

### MEMBERSHIP IN GUILD NOW OFFERED FREE

HOME workshop enthusiasts everywhere are urged to organize local clubs and join the National Homeworkshop Guild. Dues to this organization have been abolished, and its services are now given free to all clubs affiliated with it. Complete information on how to start a club may be obtained by writing to the National Homeworkshop Guild, 347 Fourth Avenue, New York, and inclosing a large (legal size) envelope, self-addressed and bearing a three-cent stamp.



An exhibit of inlaid pictures by G. N. Schalk of the Wood-Ridge (N.J.) Homeworkshop Club

treasurer. On the governing committee are John Oliveras, William D'Ettore, and C. D. Jones.

**Gaylord (Kans.) Homeworkshop Club.** Carl Motter is president; F. A. Grisier, vice president; A. E. Gledhill, secretary; Clifford Hays, treasurer.

**East Side's Homeworkshop Guild, New York City.** The club has rented a basement to be used as a workshop. Some of the members are building and erecting equipment while the others are working on a canoe.

**Galesburg (Ill.) Homeworkshop Club.** In order to get the members out to meetings, the officers have inaugurated an ingenious scheme of printing blueprints of interesting projects, sending half with the notice of the meeting, and distributing the other half at the session.

**Club des Artisans Amateurs, Trois-Rivières, P. Q., Canada.** The one-member monthly exhibition started last year continues to be an interesting feature. So far, more than twenty-five pieces of craftwork have been shown. The first annual exhibition was held in July, and plans are being made also for a midsummer picnic.

**Santa Monica (Calif.) Homeworkshop Club.** Each member has agreed to make something to contribute to the club. . . . Moving pictures of lumbering in the Pacific Northwest were shown at a recent meeting, and Dr. Frank C. Clark, president, gave a lesson in carving. . . . Plans for the future include an exhibit at a local hardware store and a barbecue.

**Tri-City Homeworkshop Club, LaSalle, Peru, and Oglesby, Ill.** Ray S. Lindenmeyer is president; Joseph C. Rucinski, vice president, and H. M. Cobleigh, secretary-treasurer. Residents of the three towns are invited to join this new club.

**Manitoba Model Makers' Club, Ninette, Manitoba, Canada.** Eight outside patients at the Manitoba Sanatorium recently organ-

## WHITTLED WOODEN SHOES

(Continued from page 74)

used for coats. The pair of children's sabots shown in one of the photographs have very soft and pliable white buck tops.

The heel cap is brought around the heel of the wooden sole and tacked in place, the flatter curve being the one tacked. Tack the toe leather at the sides first, starting at the heel line. Stretch the leather forward as you tack, until just at the front two overlaps or "tucks" are made, as shown, to form the toe cap.

The Japanese clog, Fig. 3, is a sandal with toe peg and a pair of 1-in. high crosspieces nailed or screwed on the bottom. The crosspieces were originally put on the sandals to keep them out of the mud.

The German or Dutch wooden shoe must be made in three parts, as indicated in Fig. 5.



The most familiar type of wooden shoe—and the hardest to make—is carved from one piece

Start again with the wooden sole, but make it about  $\frac{1}{2}$  in. wider all around than you did before. Then cut out a foot outline in a thicker piece (about 1 in. thick for a boy, and  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in. for a man), shape it on the outside edges to match those of the sole, and cut the inside with a scroll or compass saw. The top element is another 1- or  $1\frac{1}{4}$ -in. board, hollowed out as shown. It covers the foot as far back as the instep. Glue and nail or screw the pieces together, and when the glue dries, shape the shoe to the general shape illustrated. Then sandpaper, soak the outside thoroughly with linseed oil, and finish by painting or enameling.

If you want wooden shoes just for ornaments, make them of a single piece in any size from 1 in. to 6 or 8 in. long. The interior is hollowed out as well as possible with a knife. These make very attractive souvenirs, flower holders (for tulips in spring, for example), paper weights, pincushions, or knickknacks.

## GRAPHITE AS LUBRICANT HAS MANY SHOP USES

ONE of the most useful nickels worth the home workshop owner can buy is a stick of bicycle-chain graphite. This may be applied to any part requiring lubrication where oil or grease would be undesirable. Some of the places where it is effective are: cross slides and lead screws of lathes, lathe chucks, vises and C-clamps, blade guides of jig saws and band saws, table-tilting and raising mechanisms of bench saws, and exposed gears; in fact, any parts that are likely to pick up dirt and grit if lubricated with oil. Graphite is also better than oil for lubricating the tail-stock center of a lathe in both wood and metal turning.—CARL FROEN.

## MEASURING WITH CIGARETTES

If no ruler is available, an ordinary cigarette makes a handy and fairly accurate measuring rod. All standard brands are  $2\frac{3}{4}$  in. long, and because they are machine cut, the variation is less than  $1/32$  in. It is easy to estimate one half the length, which would give  $1\frac{1}{8}$  in., or one quarter the length,  $11/16$  in. Four cigarettes laid end to end measure 11 in.—K. F. KEITH



# For Clean-up King I Nominate...

By Lou Gehrig

*New York Yankees' Clean-up Ace Makes Novel Choice for All-Time Honor*

I DON'T need to tell baseball fans how important the "clean-up" (number-four) man is in the batting line-up. With three reliable hitters batting ahead of him, it is his wallop that brings in the runs.

In my thirteen years of big league baseball I have watched some of the most famous "clean-up" men in the history of the game. But the other day in Boston I had the pleasure of seeing the "clean-up" king that gets my vote for the "all-time" honors. Strangely enough, this "clean-up" king isn't a slugger at all. Instead of cleaning up the bases, this one cleans up faces.

Here's how it happened. While in Boston playing the Red Sox, I made an inspection trip through the Gillette Safety Razor factory. There I discovered that what is true of baseball is also true of Gillette Blades. In baseball, the pick of the raw material is tried out, tested, and trained for the big league teams. At the Gillette factory I found that they buy only the finest steel, and put it through gruelling tests before it is made into Gillette Blades.

For instance, like a rookie baseball player, Gillette Blade steel has to be hardened

and tempered. To do this, Gillette uses electric furnaces, each one controlled by a device which can tell in an instant if the steel passing through the furnaces requires more heat or less heat. Faster than a speed-ball, the signal is flashed from the box to a great battery of switches, and the heat is raised or lowered accordingly. Then to make doubly sure that there is no possibility of error, they X-ray the steel with an electro-magnetic tester to detect hidden flaws.

A good ball player has to have precision and accuracy, too . . . and that's where Gillette chalks up a winning score. Grinding machines, adjustable to  $1/10,000$  of an inch give Gillette Blades shaving edges so keen you can't see them, even with the most powerful microscope.

These are some of the reasons why I nominate the Gillette Blade for all-time Clean-up King. For when it comes to cleaning up on stubborn bristles—with the greatest of ease and comfort—Gillette hits a home run with the bases loaded. Yes, Sir!—if baseball could only train players as accurately and efficiently as Gillette makes razor blades, we'd all bat 1000.

With these important facts before you, why let anyone deprive you of shaving comfort by selling you a substitute? Ask for Gillette Blades and be sure to get them.

**GILLETTE SAFETY RAZOR COMPANY, BOSTON, MASS.**



## GLEAMING TILE WALLS AT LOW COST WITH **MASONITE TEMPRTILE** (WOOD-FIBRE BOARD)

• Building a new home? See these beautiful bathroom walls even the most modest budget will buy—with **MASONITE TEMPRTILE**, a wood-fibre board. Does away with hours of cleaning. Makes the entire room cheerful, spotless, sanitary.

And does it save money? It comes in boards, already scored, and costs so little that it ordinarily doesn't amount to more than regular wall surfacing. A carpenter just cuts it to fit and nails it right into place. Then a painter comes in and finishes it. And that's all there is to it.

But that's just the start of the saving. **MASONITE TEMPRTILE** is grainless and moisture-resisting. It won't warp out of shape. The finish won't chip off and have to be touched up. And these walls will outlive lots of other materials.

No house is too large or too small to be equipped with **MASONITE TEMPRTILE** in bathroom and kitchen. Mail the coupon for free sample and complete information.

## GENUINE **MASONITE TEMPRTILE**

Tempered Presdwood  
Structural Insulation

Quartboard  
Insulating Lath



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Please send me a free sample and further details about **MASONITE TEMPRTILE**, the modern tile material.

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# BLUEPRINTS

FOR YOUR

## Workshop Projects

**Y**OUR home workshop will give you considerably more pleasure if your work is planned in advance. To assist you, **POPULAR SCIENCE MONTHLY** has prepared a wide variety of blueprints with working drawings of well-tested projects. If you do not see what you want in the list below, send a self-addressed stamped envelope for our complete list.

The blueprints, which have been prepared by experts, are 15 by 22 in., with a few exceptions. They should be ordered by their numbers, which follow the titles and are in italic type. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter *R* follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions, which supplement the drawings. If you do not wish this supplement, omit the letter *R* from your order and deduct 25 cents from the price given. The instructions alone may also be obtained separately, if desired, for 25 cents each.

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Cedar Chest, 17.....	.25
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### MODELS

{ Construction kits are available for  
some of these models. See page 92. }

Airplane Racing Model, Twin Pusher (35-in. wing spread), 86.....	.25
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Coast Guard Patrol Boat (20¼-in.), 285-287-R.....	.75
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Liner— <i>Aquitania</i> (9-in.), 225.....	.25
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Liner— <i>Queen Mary</i> (10¼-in.), 283.....	.25
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Tugboat, Harbor (11¾-in.), 284.....	.25
Tugboat, Water-Line (5 3/16-in.) and Barge (7 3/16-in.), 285.....	.25
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<i>Winnie Mae</i> , 4-ft. Flying Scale Model, 141-142-143.....	.75
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Canoe, 16-ft. Canvas-Covered Kayak, with sail, etc., 192-193-194-R.....	1.00
Combination Boat, 15-ft., for sail, outboard motor, or oars, 131-132-133-R.....	1.00
Duck Boat, Canvas-Covered (13 ft. 6 in. long; weighs 60 lb.), 279-R.....	.50
Duck Boat, Folding, (13-ft.), 170-R.....	.50
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15¼-ft. Runabout or "Sportboat" (outboard or inboard motor), 175-176-177-R.....	1.00
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353 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows.

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Name .....

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Please print your name and address clearly.



**WHEN** it is necessary to plug holes in metals having a crackle paint finish, use sealing wax of the same color as the paint, and approximate the design by engraving the wax with a scriber. The deception will be practically perfect.

A little bichromate of potash added to hot glue immediately before use will make it insoluble in water.

Characters for identification purposes can be readily placed on steel and metal bars with rubber stamps and printer's ink, and protected with a thin coat of shellac or lacquer.

When driving dowels in dies or other metal components, mutton tallow is preferable to the oil-and-white-lead mixture commonly used because it doesn't dry out so readily.

Sheet metal, like wood, has a grain. To prevent failures due to fractures, sharp bends should be made at right angles to the grain.

## GRACEFUL COFFEE TABLE

(Continued from page 66)

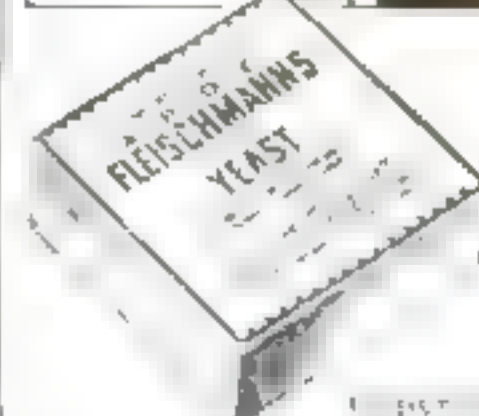
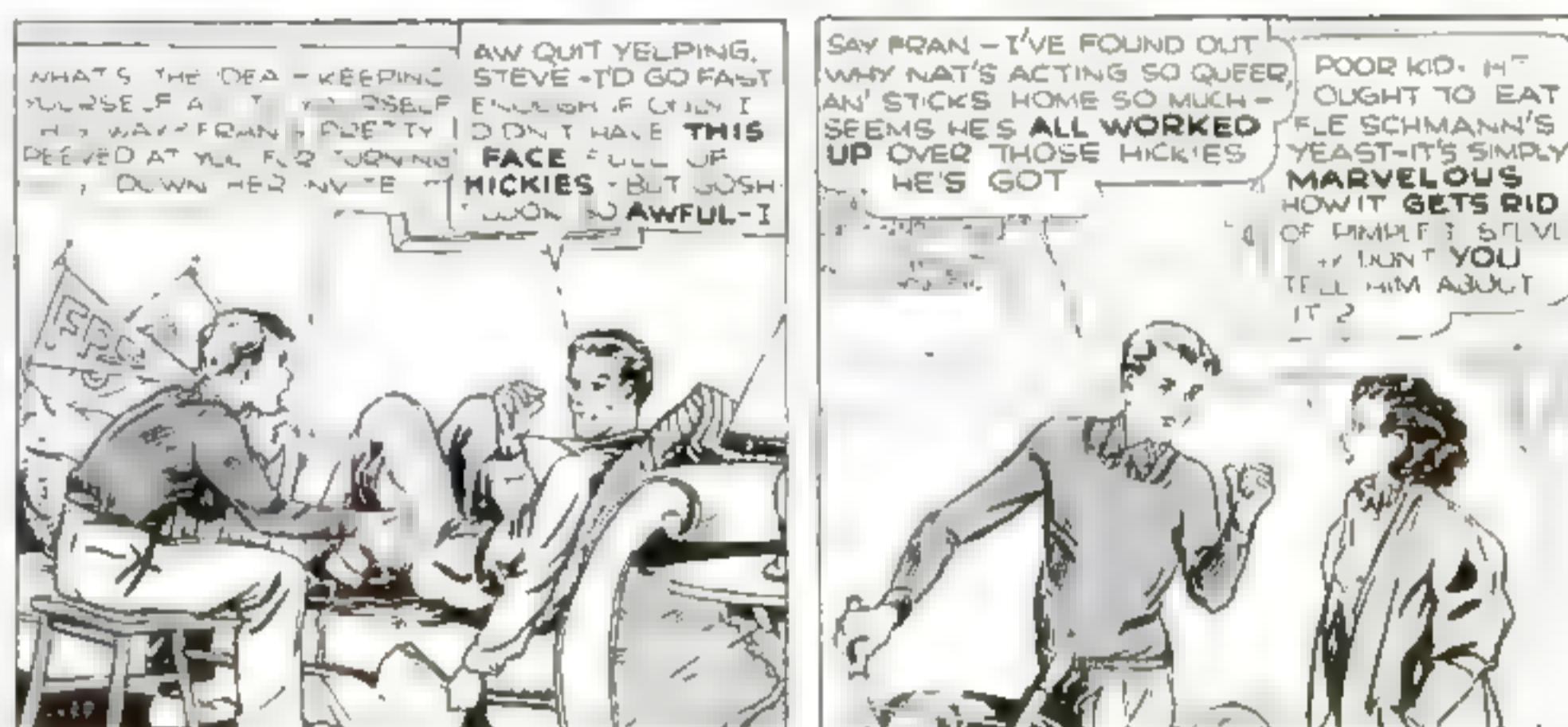
The beauty of scrolls of this nature lies in a natural and free flow of one part from another. The points of contact must not be distorted, or the shape of the curve changed in assembling. The fact that brazing was used at these points in the table illustrated accounts for the absence of rivet heads; and this is perhaps the easiest method of assembly. The parts of the first leg are laid down in their proper relation to each other and heated on the upper edge; then the brazing rod is applied to the points of contact in the order as numbered.

If riveting is the method of assembly chosen, the marked points of contact can be carefully center punched and drilled for 3/16-in. roundhead rivets. Contact No. 1 will be hardest to rivet, so should be done first. The round shape of the head may be retained by drilling a 1/4-in. socket in the head of a piece of scrap iron or by using a standard rivet set. With the socket held in a vise, the rivet head is rested on the socket and the rivet ball-peened to an oval shape on the other end. If the heads are placed on the sides of the stock where the numbers appear on the drawing, they will look most uniform.

Each leg after assembly should be straightened and trued up to the sketch. They are then ready to be fastened to the top and shelf. The underside of the wooden parts should be laid off, and the screw holes drilled for 1/2-in. No. 8 roundhead screws. The shelf must be attached by blocking it up to the right height on the bench and protecting its finished surface with a cloth padding. The top is then attached in a similar manner, and finally the band or ring is riveted in place between the legs at point No. 7 by bucking the rivet heads inside the scroll and peening the rivet ends from inside the ring.



## A pimply skin made Nat hate to go places



*clears the skin*  
by clearing skin irritants out of the blood

## Don't let Adolescent Pimples make you miss out on Good Times

**N**EARLY all boys and girls are subject to pimples after the start of adolescence—from about 13 to 25. At this time, important glands develop and final growth takes place. Disturbances occur in the body. The skin gets oversensitive. Waste poisons in the blood irritate this sensitive skin. Pimples appear!

Fleischmann's Yeast clears these skin irritants out of the blood. Then, pimples go! Eat 3 cakes daily—one before meals—plain, or in a little water—until your skin clears.

**I CAN PATCH  
THIS TOP with  
GENUINE  
PLASTIC WOOD**



Damaged or leaky tops or rotted posts are easily repaired by applying Plastic Wood firmly into cracks or holes—allow to harden—sandpaper smooth. Fabric patches can be cemented over Genuine Plastic Wood.

## MAKES 1001 REPAIRS

Genuine Plastic Wood is used to repair damaged or leaky automobile tops, broken furniture; reset loose bathroom fixtures, loose casters; fill old screw holes, baseboard cracks, shelving cracks; replace wood rot, fill holes around pipes and wiring; leaky window frames, damaged wood, cracks around bathtubs, floor cracks, loose handles; molding decoys or fishing lures, repair broken toys, boat and canoe repairs, etc.

## EASY TO USE

Genuine Plastic Wood is actual wood in putty form—when dry it is hard wood that can be worked with any wood-working tools—sawed, planed, turned on lathe, carved—will hold nails and screws perfectly without chipping, cracking or crumbling. Adheres to any clean, dry surface—wood, metal, glass or porcelain—is waterproof and weatherproof; can be painted, varnished or lacquered perfectly. Plastic Wood comes in nine different colors to match all finishes including white.

Get your can or tube at any leading paint, hardware or variety store.



**PLASTIC WOOD**

## DINNER BELL CARVED IN MAORI STYLE

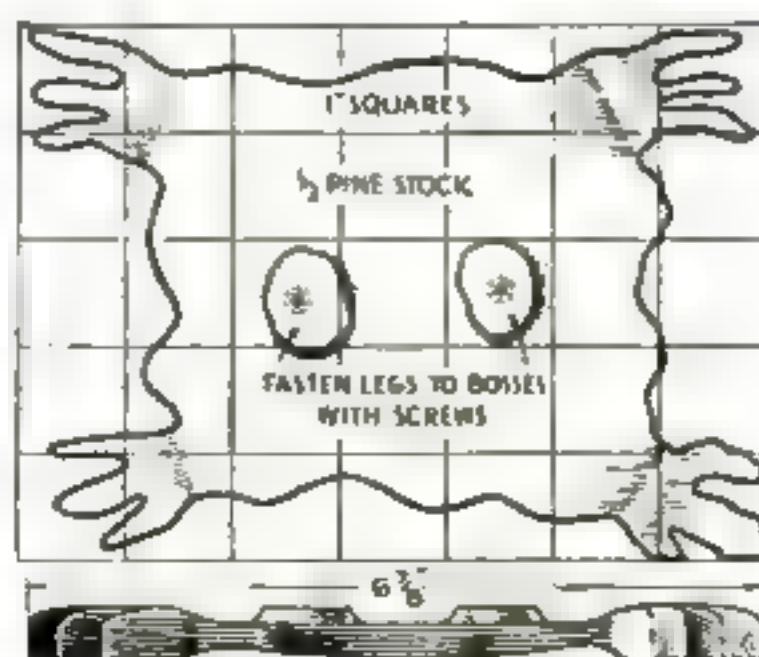
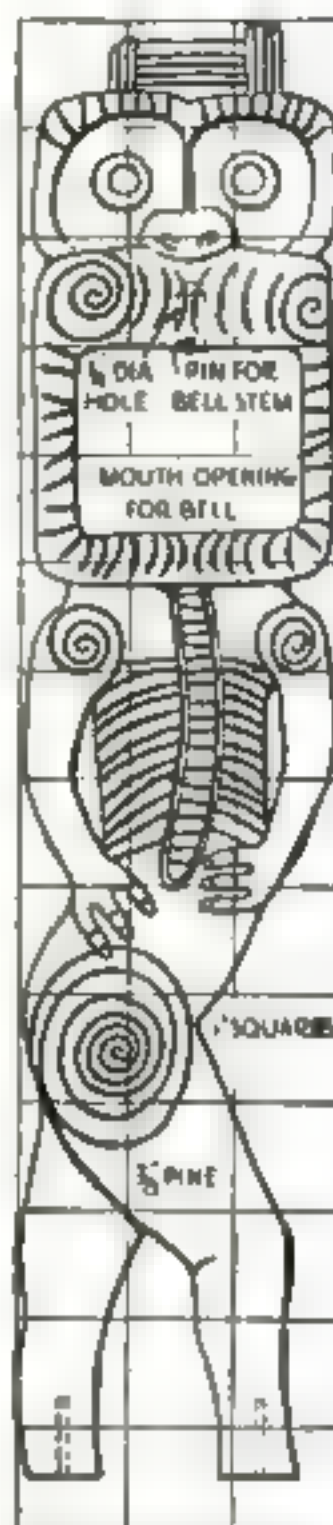
FROM "down under" in New Zealand comes this dinner-bell design. The carvings of the Maoris have been admired ever since the time Captain Cook sailed in that wild Polynesian archipelago, and by carving this figure we can construct an ornament typical of their work.

Much of the wood may be removed by jig-sawing. Rounding the outlines and sanding are then the only operations to be done by hand. Even these may be done with a flexible shaft having routing cutters for carving and small, shaped sanding wheels.

Good solid white pine is excellent for carving. The stock for the figure is 13½ by 3 by ¾ in.; for the base, 5 by 7 by ½ in. Lay out the patterns for these pieces, using 1-in. squares on a sheet of paper. The pattern could be drawn on the wood itself, but in rounding the shapes, detail lines would be removed and have to be redrawn. Keeping this in mind, transfer the major outlines to the surface of the stock with carbon paper.

Follow the lines accurately because Maori carvings are truly symmetrical in form. Small projections of wood should be left at top and bottom of the pieces so that they may be held down to a carving board by nails through these waste parts. When the carving is complete but for these projections, they are sawed off and the surfaces at these points finished. Because of the irregular shapes, the carvings are better held this way than with a vise, which might also mar the soft wood by crushing the fibers in places.

The only inside sawing is at the arms and mouth. Using gouge, chisel, and jackknife, bring the rough-sawed shapes to a curved form. At this stage, the tattoo marks are traced on and then cut with a sharp knife. You will no doubt pause at the three-fingered hands, but this is an oddity peculiar to Maori carved figures. It honors the memory of their

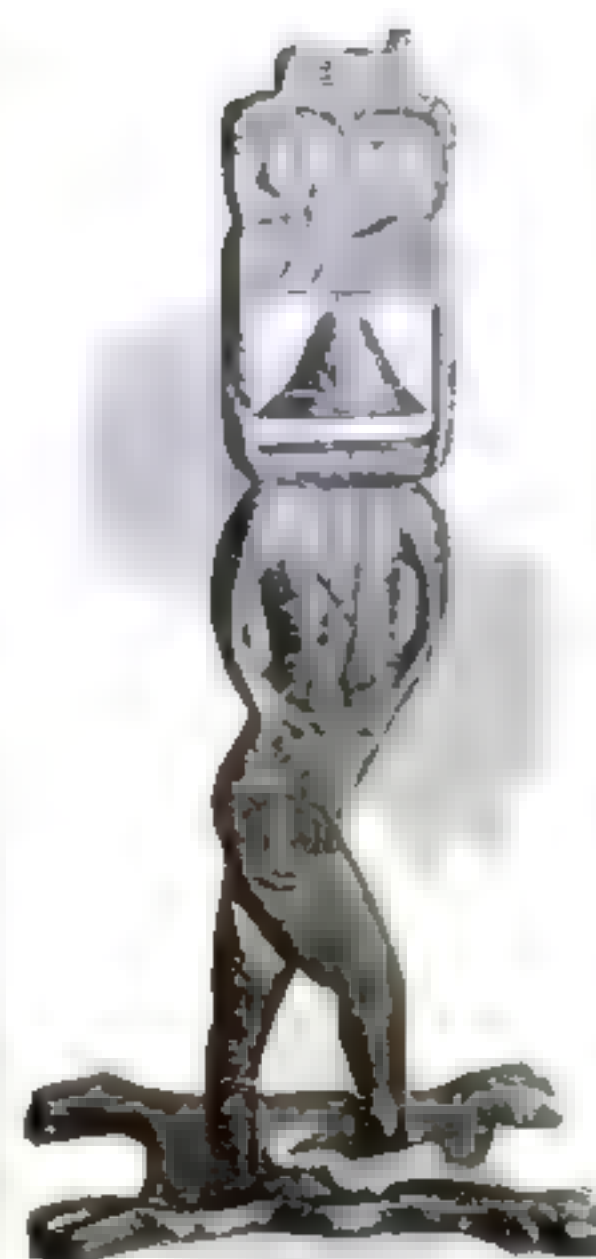


How to lay out the base, and an edge view showing the bosses for the feet

first wood carver, believed to have been created thus. This ancient warrior also has a battle scar on his tattooed chest and another at the side of his mouth.

The back of the figure is left plain. Using as much leeway as you can, drill two converging ¼-in. holes in the roof of the figure's mouth. Sand all surfaces free of tool marks.

In making the base, leave the feet the orig-



This Maori dinner bell is a good project for the beginner in wood carving

inal thickness of the stock and carve both sides of the remainder down to 5/16 in. Slight bosses are left flat to which to fasten the legs of the figure with screws and glue. Run a small drill into the legs before fastening with screws so that there will be no danger of splitting.

Next is the fitting of the bell or gong. Ten-cent stores usually have imported brass dinner bells that are just the thing. As shown in the photograph below, the handle is cut off 5/8 in. above the bell, and a hole is drilled through it for the hanging pin.

The handle for this particular bell portrays a crane or stork and makes a fine striker when the cut end has been rounded. Hang the bell on a brad so that it is placed correctly in the mouth. Then remove the bell and brad for convenience in finishing the wood. Color everything but the eyes a rich magenta or brick red, using weak paint. The eye pupils are black, surrounded with white.

The striker is laid conveniently on the base of the completed dinner gong so that you can give voice to your little Maori friend by striking his brass tongue.

This simple little carving project is quite easily and quickly made, yet forms an ideal gift at any time. The cost for materials is small.—D. W. P.

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## SMALL CORNER CABINET

(Continued from page 64)



Cutting grooves for shelves with dado head on saw table. Stop the cut before it runs through, and square up with hand chisel at front end. Note the reversed cross-cut slide

these pads  $\frac{1}{8}$ -in. thick gasket rubber is ideal, but heavy cardboard or a stack of newspapers will serve—anything to distribute the clamping pressure and to absorb inequalities.

The core can be made of two pieces of  $\frac{3}{16}$ -in. basswood three-ply board with one ply on each piece cut through at intervals to permit bending. These should be about 6 by 8 in., with the outside grain running the long way. The veneer should be the same size with the grain running the short way. Cut the face veneer for both doors from the same sheet so the grain will match.

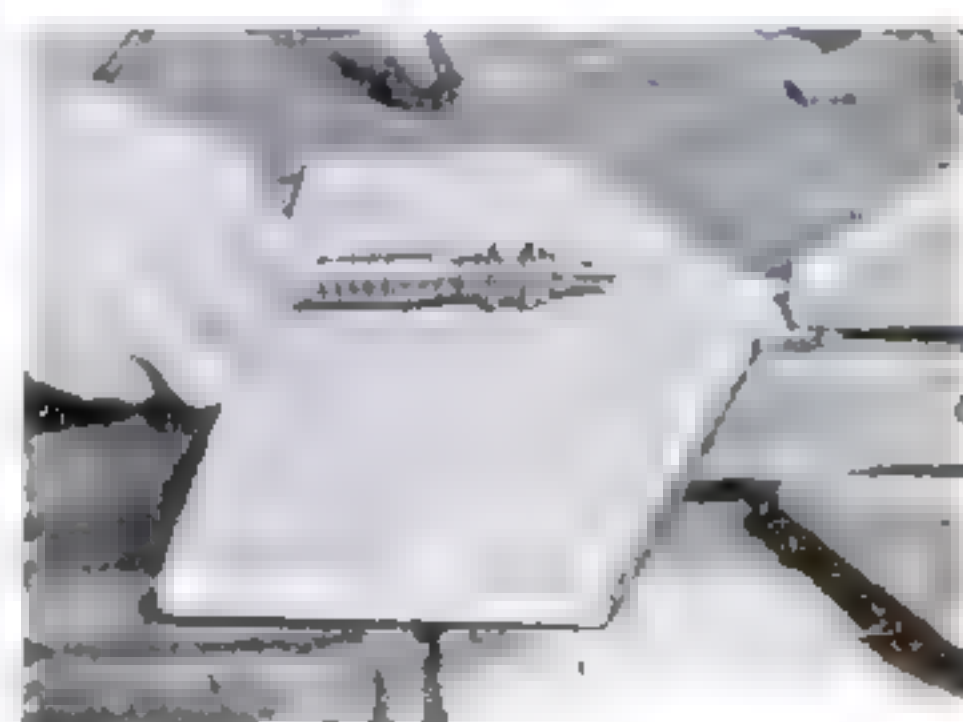
In gluing up maple or any other light-colored or figured veneer, guard against the penetration of glue to the outside through the pores by mixing the glue rather thicker than usual and coating only the cores. This applies particularly to burl and crotch cuts.

Glue up each door in turn, using plenty of pressure as shown in one of the illustrations.

The sides and shelves are then cut out and fitted together by the grooved-and-screwed construction suggested on the drawings. The doors may be fitted and pivoted on the metal pins through holes previously drilled in the shelves at the points indicated. Disassemble all parts for finishing, which may be done better "in the flat."—DONALD A. PRICE.

## STABLE HOLDS NECKTIES

(Continued from page 65)

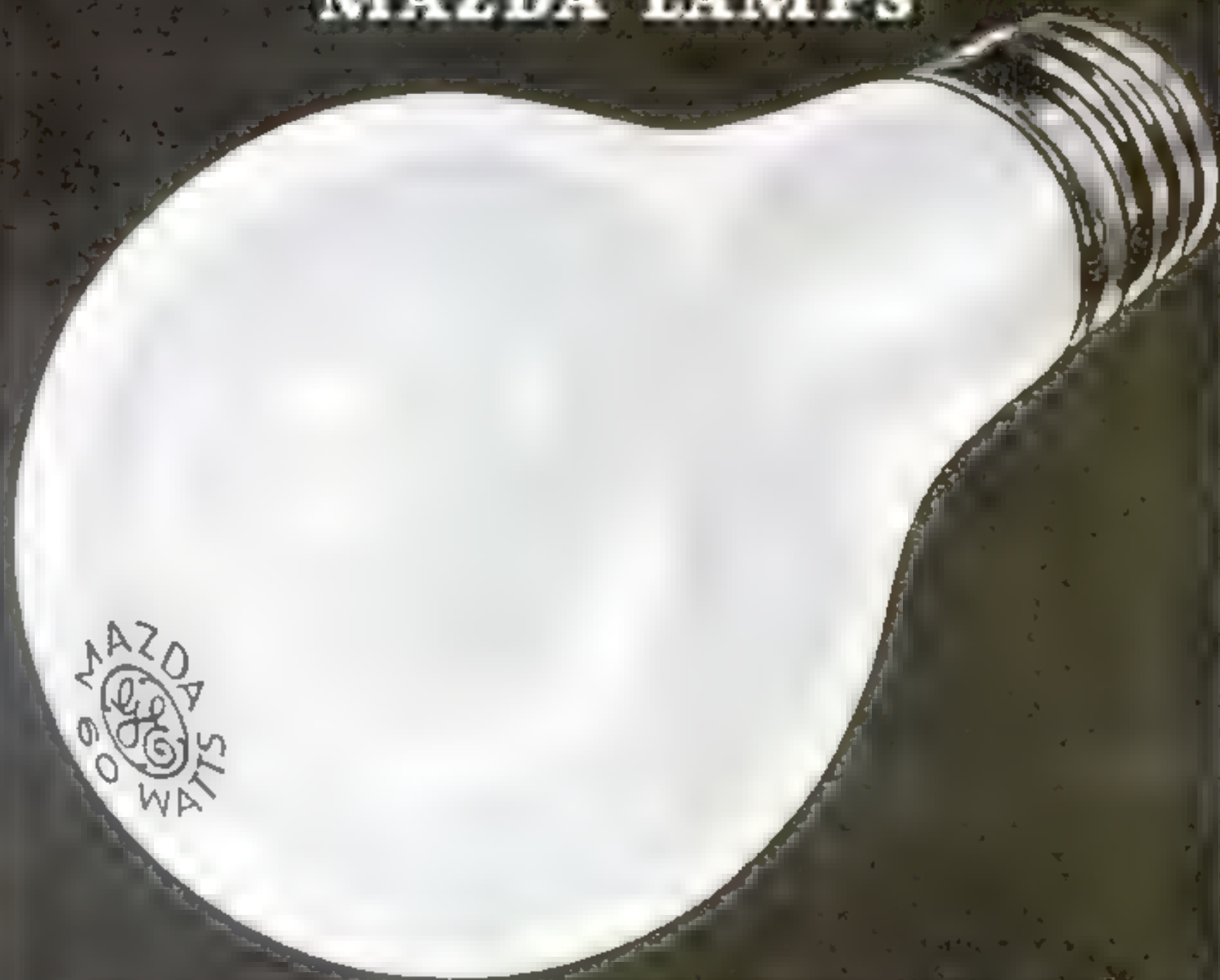


The grooves to represent the siding are cut with a fluting cutter in the flexible shaft

The bits are made by running thin wire through the head and forming rings on each end. Calfskin lacing  $\frac{1}{8}$  in. wide is used for the bridle leather. The straps are attached to the head with cement and small nails to represent the rosettes on the bridles. The heads are secured to the barn with screws from behind. The bridle reins are then fastened to hitching rings on the side of the barn.

The barn is given two or three coats of enamel. The horses are stained brown, and the "stars" in their foreheads are painted on. The barn may be hung on the wall by a nail or screw in the ventilator at the top, and the ties are merely drawn over the reins, which serve as loops.—D. C. MARSHALL.

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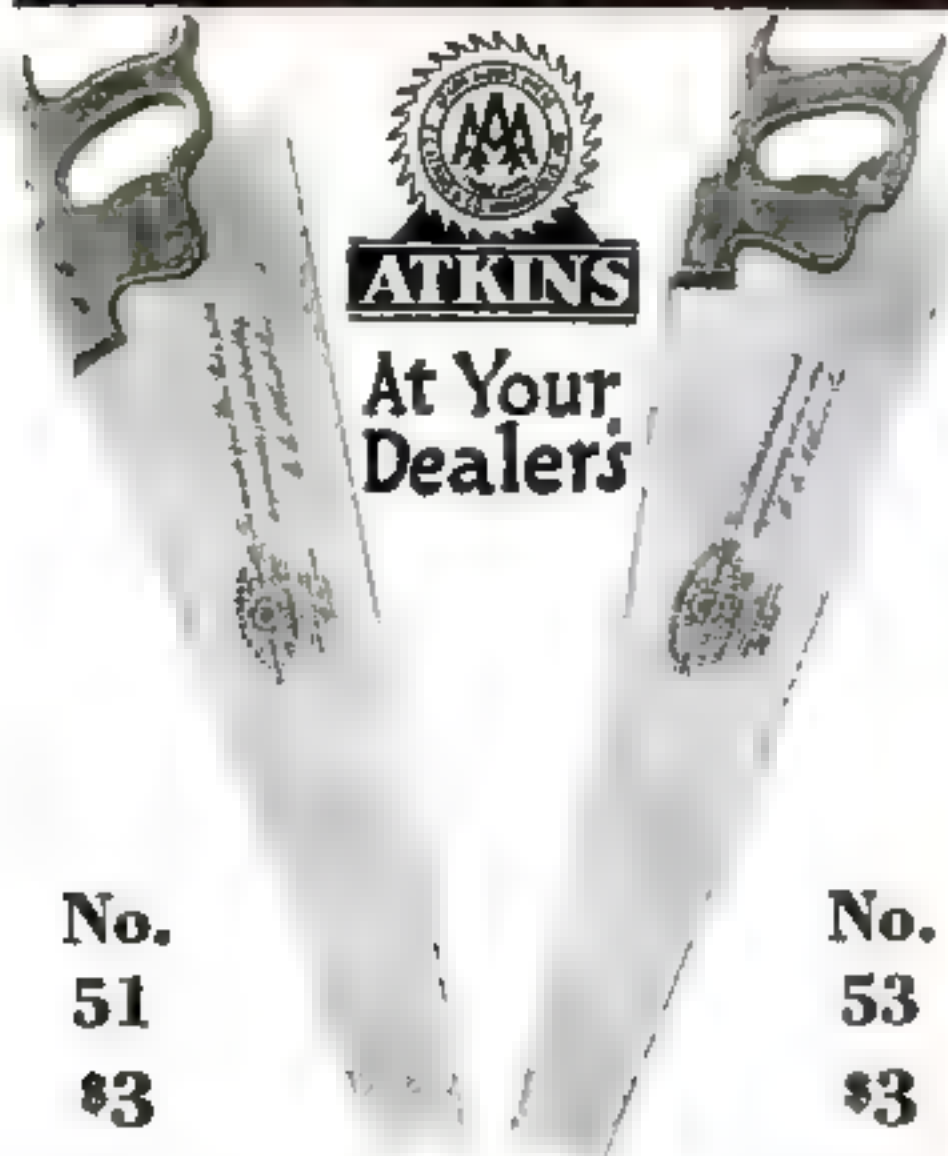
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## AMAZING VOYAGES IN TINY SAIL BOATS

(Continued from page 31)

takes expertness in seamanship, as well as in navigation, to make such voyages. And sometimes, in spite of their skill, the round-the-world sailors meet disaster.

Such was the fate that finally overtook Capt. Joshua Slocum, one of the first of the "Midget Magellans" whose stirring adventures are recounted by Eric Devine in a book of that title, published recently by Harrison Smith and Robert Haas, Inc., New York City. After having blazed a trail around the world in his sloop *Spray*, he sailed one day from Newport, R. I., on a new voyage and was never heard from again. Crossing the steamer lanes on the way to the West Indies, he is thought to have been struck by some large vessel during a fog



Tea at the captain's table—Alain Gerbault with a gasoline stove of a type used at sea

It was Slocum's solitary round-the-world cruise, about the turn of the century, that inspired many of the small-boat voyagers of the present day. After spending thirteen months rebuilding an old sloop for the purpose, this former sailing-ship master took *Spray* out of Boston, Mass., for Nova Scotia, and then crossed the Atlantic to the Azores in eighteen days. At Gibraltar, he was warned of longshore pirates in the Mediterranean and Red seas, so he turned back, and after forty days reached Pernambuco, Brazil.

PASSING through the gale-swept Strait of Magellan, named for the famous explorer who first circled the globe, he met new hazards besides the weather. Lawless natives threatened to board and plunder the boat, but were foiled by ingenious defenses. Clothing, draped scarecrow-fashion in the cabin, convinced the robbers that Slocum had a companion. They waited till he slept, and slipped aboard; but he had strewn carpet tacks on the deck! These caused yowls that brought Slocum from his bunk with a shotgun.

He went on, by way of various islands, to Australia, South Africa and back to Brazil; thence to the West Indies, and finally home to New England. In three years and two months he had gone 46,000 miles.

At times, *Spray* averaged better than 150 miles a day. Like other good boats, she could hold her course without a helmsman. Slocum covered one 2,700-mile stretch in twenty-three days, and spent only three hours of that time at the wheel!

Disliking navigation by means of celestial

observations, Slocum nearly always relied upon his chart, his compass, and his log line—a long rope towed astern with a blade at the end to make it spin, and a clocklike device registering the turns in mileage, as a sort of nautical speedometer.

This method of navigation, called "dead reckoning," always of value to the mariner between the times when celestial observations are taken, was used by many old-timers almost to the exclusion of other means.

Slocum did carry a sextant, however. Once, when he had traveled forty-three days from Juan Fernandez Island, in the Pacific, without using it, he took a sight just to check up on his dead reckoning—and found that he was five miles off. An error of five miles in forty-three days!

A REMARKABLE feat of navigation of a different kind, saved the life of Capt. John Voss, another round-the-worlder, after a midocean tragedy, some years later.

Sailing with one companion who served as mate, he met a storm the second day out of Suva, in the South Sea Islands. The mate went on deck at midnight and neglected to fasten himself with a lifeline. A huge wave suddenly engulfed the ship and swept him overboard!

Voss quickly lowered all sails and threw out the sea anchor, a sort of canvas bag designed to drag in the water. But his shouts brought no reply. The man was lost.

Then the Captain, alone on the ocean, discovered a menace to his own life. The boat's only compass had gone overboard with the mate!

For three weeks Voss, an old-time seaman, steered by taking daily celestial observations, and watching winds and currents—until he arrived safely in Sydney!

His entire voyage was an amazing one. He had made his ship from an old Indian canoe, cut from a solid cedar log. The strange craft was thirty-eight feet long, and when fully loaded had a draft of only about two feet!

Its seaworthiness was demonstrated when they had sailed just a week from the west coast of Canada. They encountered a storm. Voss turned the boat around, into the wind, and dropped the sea anchor from the bow. It dragged through the water with just enough pull to keep the ship meeting the waves properly, and they weathered the gale with ease.

Using a sea anchor during storms, as Voss did, was an important knack in the seamanship which took William Robinson, New England youth, safely around the globe in his little thirty-two-foot ketch, *Svaap*.

One of the Pacific storms he weathered, hove-to and with the sea anchor out, was so violent that when he reached the island of Vate, shortly afterwards, he found the waves had nearly demolished the sea wall.

ROBINSON, who according to latest reports is in Tahiti, made the world trip with one companion a few years ago. Instead of skirting the lower tip of Africa, as most of the other small-boat sailors did, they performed the amazing and daring feat of sailing through the Red Sea, in spite of calms and the almost incredible phenomenon of a sandstorm—and pirates.

They were captured twice, off the coast of Arabia. Once Robinson and his mate gained freedom by bribing a minor chieftain who didn't like the Emir. Once they escaped because their captors were unaware that *Svaap* had such a modern appurtenance as a ten-horsepower auxiliary motor!

While the pirate craft which guarded them was nearly becalmed, they suddenly started the engine. A few (Continued on page 91)

## AMAZING VOYAGES MADE IN TINY SAILBOATS

(Continued from page 90)

shots from a gun which they had hidden threw the surprised Arabs into further confusion; *Svaap* headed straight into the slight wind, until pursuit was futile!

An auxiliary engine might have saved the voyage of Erling Tambs from disaster of another sort, recently. But Tambs, a Norwegian journalist and an experienced seaman, disdained motors as corruptions of the pure art of sailing. He bought a forty-foot pilot boat which had been retired when power ships came into use. He refitted *Teddy*, as the craft was named, with his own labor, at a cost of nearly \$2,500. Then, with his bride, he sailed on a honeymoon.

**B**EFORE a mishap ended the trip, they enjoyed about three years at sea and in various ports from Norway to Australia. Two children were born; when the first was ten months old, they rigged a canvas harness, fastened to a rope, to hold him safe while he played on deck.

Disaster overtook them after they had gone as far as Australia, where the *Teddy* won the first trans-Tasman yacht race. They were rounding a rocky shore of New Zealand, when the wind suddenly died. A fast current was sweeping inward. An auxiliary motor might have overcome it. Tambs worked frantically with an oar, but in vain. All on board were rescued, but *Teddy* was smashed on the rocks.

Tambs later confessed that he picked up pieces of the wreckage and kissed the planks goodbye. A man comes to love his boat. When the family returned to Norway, Tambs bought another double-ender boat, and recently sailed across the Atlantic to Newport, R. I., and back.

A difficulty encountered by Tambs, and by most of the other Midget Magellans, was damaged rigging. One of the fiercest struggles against this hazard was made by Alain Gerbault on the world cruise he completed a few years ago.

Gerbault, who is a wartime aviator, an engineer, and a professional tennis player, made the trip in a boat designed as a "racing cruiser"—but probably not meant for the strain of crossing oceans. The boat, *Firecrest*, was thirty-nine feet long, with a beam of only eight and a half feet and a draft of more than seven feet. She wouldn't sail well alone, so Gerbault frequently had to heave to while he slept. He took 101 days to cross from Gibraltar to New York.

In a fierce storm, Gerbault saw a monstrous wave coming, and barely had time to climb the rigging before tons of water shut the ship below him from his view. When the boat fought her way back to the surface, the bowsprit was hanging broken, battering and threatening to smash a hole in the hull.

**A**FTER that had been remedied, the shrouds loosened and the mast began to sway perilously. Gerbault climbed up, tied himself securely, and made repairs again. One by one, other pieces of equipment failed, and had to be repaired. The mast was the only part of the rigging which stood the entire voyage.

That mast is now preserved, as a sort of memento, on a new thirty-four-foot boat, built for ocean voyaging, in which, according to latest reports, Gerbault is sailing among the South Sea Islands. He has another memento, also, of the first voyage: France awarded him, for his skill and daring, the Cross of the Legion of Honor.

Possessed in common by all these sailors who rove the seas in tiny boats, is the knack of meeting emergencies. Science has given the Midget Magellans vast aid, but they must be always ready with their own ingenuity—and their bare hands.

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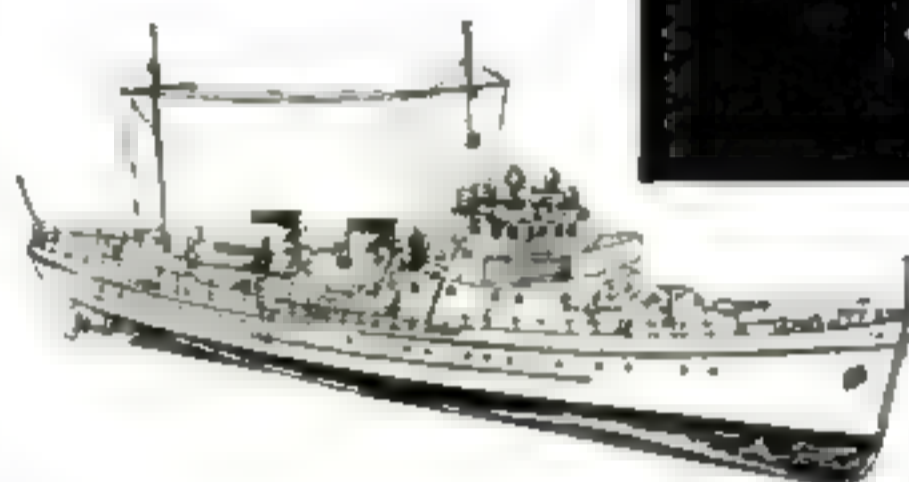
PATENTS

PENDING

A FILE FOR EVERY PURPOSE

# Learn Model Making WITH OUR CONSTRUCTION KITS

Here are the materials contained in our Coast Guard patrol-boat kit (marked 5S in the list below). The hull lifts are sawed to shape, and everything is provided for making an accurate scale model 20 3/4 in. long. The sketch shows the model as completed



**EVERYTHING** you need to make a beautiful scale model of the 165-ft. Coast Guard patrol boat recently described by Capt. E. A. McCann (P.S.M., July '36, p. 55, and Aug., p. 78) or to build any one of many other models may be obtained conveniently and inexpensively in our construction kits. The patrol-boat kit is illustrated above and is marked 5S in the accompanying list.

Each kit contains a complete assortment of raw materials, carefully selected by an experienced model maker. A certain amount of preliminary shaping has been done on practically all the hulls, and the other materials are of such sizes and shapes as to make it easiest for you to work them into their finished forms.

The models that require the least work and fewest tools are those designed for the Popular Science Model-of-the-Month Club. In an intermediate classification are the models listed under the heading "Simplified Ship Model Kits." Our standard models are larger and more advanced, although by no means beyond the ability of any painstaking and patient beginner. Several of the standard models are worth \$100 or more when finished.

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- G. Elizabethan galleon *Revenge*, 25-in. . . 7.25\*
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- Q. Privateer *Swallow*, 12 1/2-in. hull . . . 4.95†
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- 4S. Clipper ship *Great Republic*, 31 1/2-in. hull . . . . . 8.40\*
- 5S. Coast Guard patrol boat of new 165-ft. class. Full-hull model, 1/4 in. scale, the hull being 20 3/4 in. long . . . . . 4.95\*

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- M. Aircraft carrier *Saratoga*, 18-in. . . \$1.00
- N. Four U.S. destroyers, each 6 1/4-in. . . .75
- O. Liner S.S. *St. Louis*, 11-in. . . . . 1.00
- R. U. S. cruiser *Tuscaloosa*, 11 1/4-in. . . 1.00
- U. *Hispaniola*, the ship in "Treasure Island," 7-in. . . . . .50
- Z. H.M.S. *Bounty*, 11 1/2-in. . . . . 1.50
- 1M. Show boat, illuminated, 14-in. . . . 1.50
- 2M. Ocean freighter, 14-in. . . . . 1.50
- 3M. Yacht *Nourmahat*, 8 1/4-in. . . . . 1.00

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No. 8. Whittling kit for six different Scotties. Each is 2 by 2 1/4 in., sawed to shape. Paint, paintbrush, instructions, etc. . . . . 1.00

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## COPPER-COATED HAMMER GIVES LONG SERVICE

THE use of copper hammers is often required in shopwork, but those ordinarily purchased become battered out of shape in a very short time. Discarded ball-peen hammers with chipped faces can be faced with copper as shown in the accompanying illustration to give more satisfactory results. The steel body provides support for the copper face, and the life of the composite hammer is several times that of the pure copper tool. From the cost standpoint, the faced hammer is much cheaper.

The old hammerhead is heated until red hot and placed in ashes to cool. It is then ground or machined at both ends in such a way as to give the copper faces adequate support. The copper coating is applied by using an acetylene torch and some heavy copper wire, after which the new faces are machined or ground to size.—W. C.



1. Chipped hammerhead. 2. As ground. 3. Coated with copper

## HALF-TONE ENGRAVINGS

(Continued from page 77)

water and allow the ink to dry, and the half-tone screen is completed.

Fasten the screen into the back of the camera extension box so that it will be as near the ground glass as possible, both being parallel. The inked side of the screen, of course, faces the ground glass.

**Making half-tone exposures.** You can now set the camera up in front of the photograph to be made into a half tone. Both must be absolutely free from vibration. To insure this, a solid table or bench can be used for mounting both the camera and the copy board.

With the lens diaphragm open, focus the photograph sharply on the ground glass. Next, slowly close the diaphragm, meanwhile closely examining the image on the ground glass with a strong magnifier, such as a linen tester. When the diagonal cross lines of the screen come sharply into view, open the diaphragm slightly until the cross lines change into a pattern like that of a checkerboard. This is the correct setting for making a single exposure half-tone negative. A spot of glycerin on the ground glass will make it easier to judge when the checkerboard pattern has been obtained.

The time required will be somewhat more than it would be without the screen, and the best practice is to keep a record of exposures. Since contrasty "process" plates or films are used, they must be developed with a contrast developer. Aim to obtain a negative in which the dots are entirely opaque and the clear parts entirely transparent.

After you have made a few exposures and find it easy to make a good half-tone negative, it can then be printed on zinc, etched, and nailed to a block to form the finished "cut." The method used for carrying out these operations will be described in a concluding article, to be published next month.

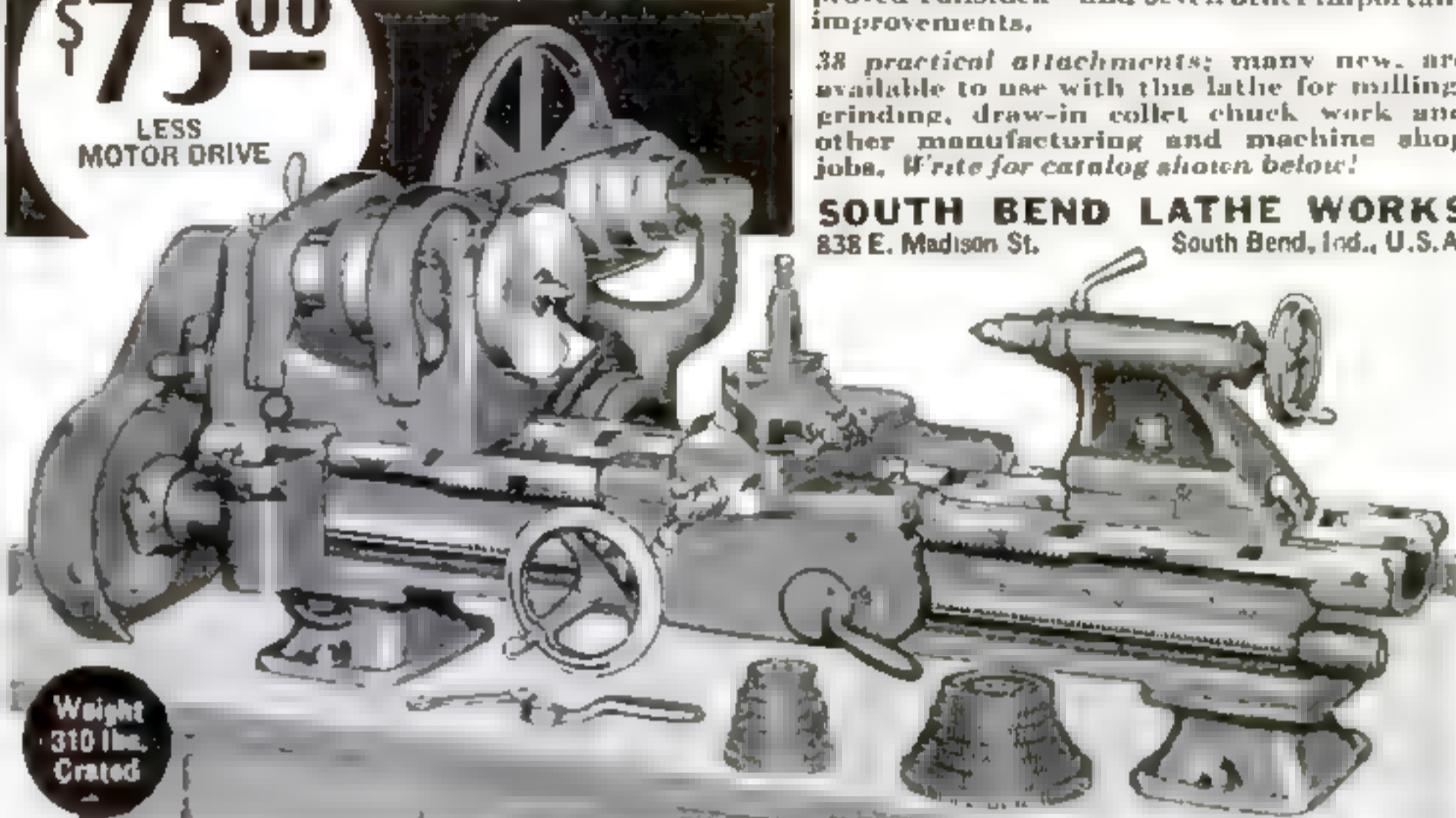
## WIRE COIL STRENGTHENS HOSE USED FOR SUCTION LINE

WHILE working with small suction lines, I had considerable trouble caused by the collapsing of the hose. Not wishing to increase the size of the hose, I solved the problem by winding a coil of wire so that it would just fit inside the hose. Although very fine, the wire furnished enough strength to withstand the suction and still provided the required flexibility.—MONTE E. KAHLBAUM

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## GETTYSBURG CANNON IN MINIATURE

(Continued from page 73)

The slotted piece (also 1/32-in. metal) with the metal strap linked to its looped end is slipped over the screw and fastened by the wing nut. The screw was taken from an old dollar watch, and the nut was also a part of the watch filed down to 3/8-in. with a small piece of metal soldered to it to serve as a wing. The strap is made of wire links holding the 3/8-in. square tin links together, each link having the ends bent over a piece of wire to form a loop at each end. The top loop of each link is bent out, and the bottom link is bent in the opposite direction. The long link that is bradded to the underside of the tongue has a loop on both ends to hold the straps for both sides of the tongue. All the fittings are duplicated on both sides of the entire carriage except the chain, the hook near the axle, and the clip for the chain ring.

The tongue strap (1/16 by 1/4-in. metal) is bent around the axle and drilled as shown. To make this look as though it is bolted on, make 1/8-in. squares of 1/16-in. metal, drill 1/16-in. holes in the center, and nail them in place with 1/16-in. roundhead rivets or escutcheon pins. By drilling holes in the wood slightly smaller than the rivets or pins, the imitation bolts can be driven without danger of splitting the wood.

THE elevating screw is made by soldering a tube 7/16-in. long around the end of a 1 1/2-in. No. 10 machine screw and drilling four 1/16-in. holes evenly spaced around the circumference for the grips or handles, which are 3/8-in. lengths of 1/16-in. wire filed to shape in a lathe chuck. The plate can either be built up by soldering a piece of metal to the 1/16-in. plate or filed to shape from a solid piece of 1/4-in. stock. The solid piece is best as it will not come apart when drilled and tapped to fit the No. 10 screw. The angle can be obtained by laying the plate in place on the tongue and filing the round center part to horizontal. The plate is best drilled and tapped after being nailed in place so that its center is 5/8-in. from the flat end of the barrel when the barrel is raised to its highest plane.

The sides of the carriage are cut from 1/4-in. wood, and rounded at the rear. These sidepieces are banded with 1/16 by 1/4-in. strips of sheet metal as shown. The top is held in place by imitation boltheads made by cutting flathead nails off short and filing the heads down to 3/16-in. diameter in the lathe chuck. The front end is held in place by six 3/16-in. roundhead rivets. (See front view.) The band is flattened at the end where it bends around the 1/8-in. radius at the bottom. The rear ends of the top and bottom bands are rounded the same as the wood.

The bearing caps are metal strips 1/16 by 1/4-in., bent around a piece of 7/16-in. round stock to form a semi-circle, and the ends are bent out and cut off 3/8 in. from the inside edge of the circle to form caps measuring 1 3/16 in. from end to end. The rounded ends of the caps can be made by soldering small pieces of wire across each end and filing to the desired shape. Each end of the bearing has a 1/16 by 1/4-in. slot cut in it to fit over the hook-and-eye lugs, which are filed to the shape shown from 1/16-in. sheet metal and put in place by drilling 1/16-in. holes through the bands and wood to receive them.

The rings for the chains are made of 3/8-in. round metal filed to shape. One is soldered to each bearing cap and two are driven into each wooden side, just a little below and to the sides of the bearing-cap edges. The caps are chained to the rings below the hook, and the eye pins which project through the caps are chained to the rings below the pins. Four small pieces of chain about 1 in. long are

needed. The eye pins are pieces of 1/32-in. wire with a small loop on the end for fastening the chain.

A is a 3/8 by 5/16-in. piece of 1/16-in. metal with a 3/8-in. length of 1/8-in. outside diameter tubing soldered to it. This is bradded in the space indicated on the drawing.

B designates the hand rings on each side of the carriage, which are made of 1/16-in. wire bent to form the letter D and are held in place by two pieces of wire flattened at the end and bent around the straight part of the D to form a hinge. These hinge wires are driven into holes as indicated.

THE offset hooks are made by bending 1/16-in. wire to the shape shown and soldering them in the holes drilled in plates of 1/16-in. sheet metal filed to shape and with holes drilled in the center to receive the No. 4 bolts. The chain hook fastened to the No. 4 bolt near the axle is filed to the desired shape from 1/16-in. sheet metal.

Place one side in position on the axle, tight against the tongue, and drill the holes for the No. 4 bolts, using the holes in the tongue as a guide to insure getting the holes in line. Remove the drilled side and repeat the same process with the opposite side.

You are now ready to bolt the sides in place. For bolts I used 3-in. nails after filing the heads down to 3/16-in. diameter and threading the ends well back with a No. 4 button die. For nuts I used No. 4 hexagon nuts filed square. Put both sides on the axle, leaving a 3/8-in. space between the tongue and the sidepieces. This 3/8-in. space is taken care of by 3/8-in. lengths of 1/4-in. dowel with a hole drilled in the center so they can be slipped on the bolts and used as spacers. Six of them are needed. The bolts are put in place with the nuts on the right side of the carriage. The front bolt has a small washer under the nut; the chain hook is placed under the nut of the center bolt; and the last bolt has an offset hook on each end.

The bottom straps for the sidepieces are put on in the same way as the tongue strap was, using imitation bolt ends with square nuts. The wire loops, which hang on the loops bent on the ends of the sidepiece bands, are fastened with 1/16-in. rivets with a small imitation hexagon nut on each end to represent small hexagon bolts and nuts. These hexagon nuts should not be more than 3/16 in. across the greatest diameter.

The barrel can be cast from a wooden pattern or turned from solid stock on the lathe. I chose the latter, because it is easier to get a good even polish on the metal. For this I used brass. I made the ears or pivots by turning 7/16-in. brass rod down to 1/4 in. on the ends and threading them to fit into holes drilled and tapped into the barrel to a depth of 3/8 in. I placed 5/8-in. washers of suitable thickness with 1/4-in. holes between the 7/16-in. diameter pivots and the barrel. The side of the washer that rests against the barrel will have to be filed and scraped to fit the round surface of the barrel.

THE chain fastens to the clip on the tongue by a small ring. The other end is linked to the hook arrangement shown in the side view. The hook is made of 1/32-in. wire and measures 1/8 in. over all. Another length of chain, both ends of which are linked to the other end of the hook, is hung on the hook just back of the axle.

The pile of cannon balls and the mounting board are optional. The balls are 7/16-in. ball bearings soldered together. It is necessary to make a frame to hold the first layer together while soldering. To fasten the balls to the board, I soldered a No. 8 machine screw to the bottom (Continued on page 95)



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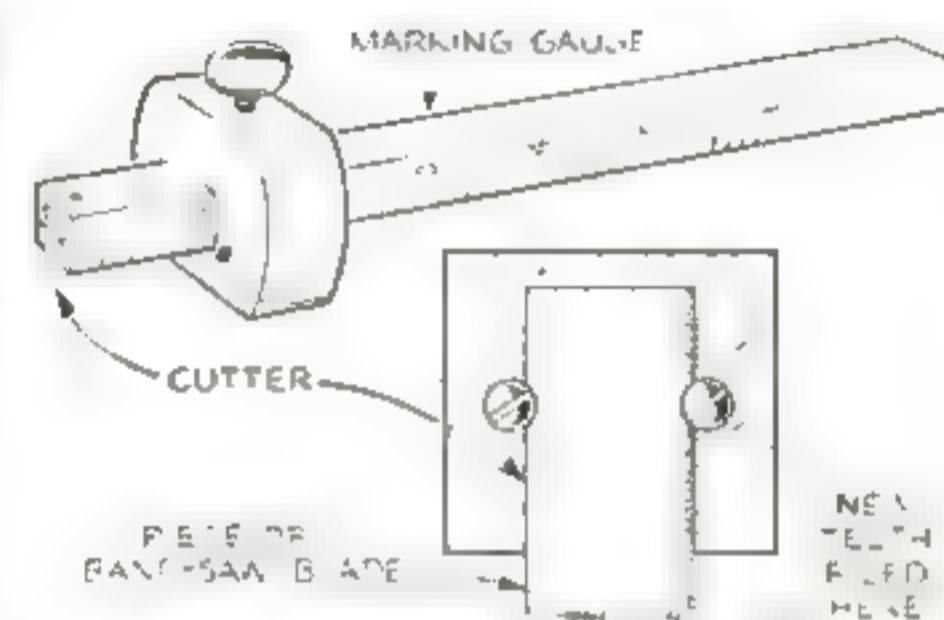
## GETTYSBURG CANNON

(Continued from page 94)

of the pile and tightened it down with a nut on the underside. The wheels are fastened to the board by small clips bent over the rim and bolted to the board, and the tongue is drilled and tapped for a No. 8 machine screw, which is screwed in from the bottom of the board.

All the wooden parts are light gray; the metal parts, black. The barrel in the model illustrated, being brass, was polished and given a coat of clear lacquer.

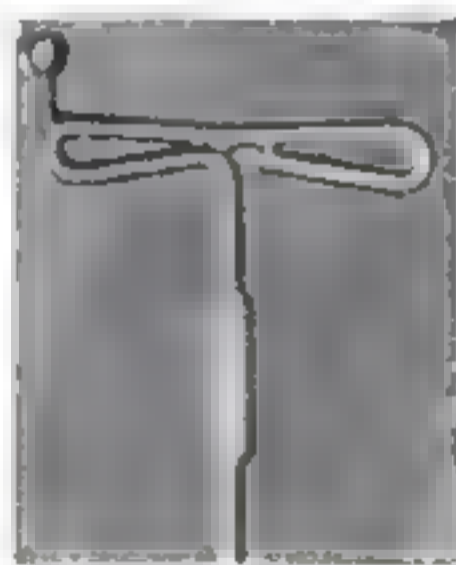
## ALTERED MARKING GAUGE CUTS INLAY GROOVES



**BEGINNERS** are often at a loss as to the easiest way to inlay bandings. What is known as a "scratch stock" is commonly used to cut the grooves, and a similar tool can be made from an inexpensive marking gauge. After removing the marking pin from the gauge, place two screws in the end of the wooden bar to hold the cutter, as shown. The cutter is a short piece of old band-saw blade (or other tool steel) with new teeth filed in one end. For narrow grooves, make several cuts. Wider grooves are made with two cuts, and the waste chiseled out.—F. A. BOWER.

## BALL HANDLE IMPROVES COMMON T-WRENCH

**TWIRLING** a T-shaped speed wrench, just before the nut tightens or after it has been loosened, may be facilitated by building up one end of the handle and welding on a short rod, with a metal ball on the outer end.—J. C.



## NAIL KEEPS BED SLAT FROM FALLING DOWN

**WOODEN** bed slats, which are often too short and as a result slide sideways and fall to the floor with a clatter, can be kept in place by driving a nail in one end of each slat and allowing it to protrude so that the slat will just drop into place. Even if the piece does shift somewhat, it still cannot turn at an angle sufficient to let it fall out.

## HAND DRILL SERVES AS SMALL LATHE FOR MAKING MODELS

**THE** model maker in a city apartment usually finds it impractical, if not impossible, to use machines. A small electric hand drill set in a small vise clamped to a table edge can, however, do duty as a lathe for small projects. Satisfactory work can be done in tapering spars, turning guns, stanchions, and the like, by setting the piece horizontally in the chuck and using a narrow chisel, files, and sandpaper.—JOHN HINTERHOFF.

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## A SATIN FINISH FOR YOUR FURNITURE

(Continued from page 75)

This stroke will expose the surface in an almost dry condition for a quick inspection, which will prevent rubbing too far before setting aside for further hardening. Wash clean with a sponge and wipe with damp chamois.

**I**N ONE of the accompanying photographs is shown a rubbing table made from the base of an obsolete drafting stand. The present top is smoothly covered with heavy gauge galvanized iron and rotates for convenience, but can be clamped rigid if desired. Such equipment is invaluable in the home workshop. On the stand are placed the materials required for rubbing—a number of clean, old rags free of buttons or snaps; one or two rubbing brushes of different sizes; rubbing felts of various sizes and thickness; and two shallow pans like cake tins to hold crude petroleum oil and FFF pumice stone (triple fine or triple floated). A bottle of polish for the final clean-up is the only other essential. Incidentally, a man's old felt hat with the brim and crown cut into various sizes and shapes is excellent for rubbing turned work of all kinds.

One of the real problems in rubbing is that of complete mechanical cleanliness. A bit of infinitesimal grit on the surface of a rubbing pad may so score or scratch the varnish that another coat is the only possible answer. To avoid this, see that all pads are scrubbed clean with a brush and gasoline first and then lay them down only on an absolutely clean surface.

Again, see that the pans are freshly cleaned and the oil strained through a piece of cloth as it is poured into the pan. Rubbing felts may be purchased as English (cheap grade), London (good grade), or Spanish (extra quality) in  $\frac{1}{4}$  by 3 by 5 in.,  $\frac{1}{2}$  by 3 by 5 in., 1 by 3 by 5 in., or any size desired. In the end it pays to buy Spanish white felt; such pads, if properly cared for, kept clean, and stored in a flat and clean can, will last a lifetime.

Keep pads for water rubbing and oil rubbing entirely separate. Never attempt to make one serve two purposes, for to do so will produce a glaze on the pad that will be almost impossible to remove, and will cut and scratch a varnish surface.

**T**HE next problem concerns itself with the pumice stone, a ground-up form of volcanic rock. Each grinding of the dry rock is floated over tanks of water, allowing the finest to float on to the second tank, where partial settling occurs to produce FF or twice floated; and the finest ground material is carried along on the surface to the third tank where it finally settles to produce FFF. Previous to use, this pumice stone should be inclosed loosely in a double thickness of cheesecloth, sifted on to a clean paper, and put into a sugar sifter such as can be purchased in a ten-cent store. This provides a quick but clean method of distributing the pumice over the work previous to rubbing.

For turned work, a rubbing brush is dipped into the oil, then touched against a paper that has been dusted freely with pumice. Hold the brush by the far end to prevent spattering while the work progresses. Rub around the sharply turned parts and lengthwise along the plain, unbroken portions. Use a piece of thin hat felt dipped in oil and pumice to complete the rubbing. Thumb off frequently the long way of the work to check the quality of the rubbing, which should be carried only far enough to produce a clean, level surface free of nibs, scratches, or brush marks. Then dip a handful of clean white cotton waste or rags in water, squeeze fairly dry, and without adding any fresh pumice pick up the oil rubbing sludge left from the pads. Working as nearly in one direction as the character of

the work permits, rub the surface to produce the satin finish so much desired.

In rubbing a flat piece such as a table top, a somewhat different procedure is in order. Wet the top with oil, sprinkle evenly with pumice stone, and cross rub the ends to cut level. Next rub from end to center, reversing the top from time to time. This will remove any traces of end cross rubbing and the double rubbing in the center is much desired. Thumb off frequently *with a lengthwise stroke only* and check against the light to see that all nibs are cut level. Use the rubbing brush to rub beaded or molded edges, then rub with the cotton waste dipped in water. Last of all, use a clean pad of waste wet with water to rub the face of the top with a stroke of even pressure. Wipe clean in the lengthwise direction only with a damp cloth and polish with a dry cloth. Inspect against the light, spot rub with the pad where necessary, dipping the pad in the oil only and without adding any pumice stone. Rub out once more with the wet waste as left from the first rubbing and reclean when through.

**A**SSEMBLE the table frame and top, if that is what the job happens to be. Then wipe and clean up with an oil polish. This may be prepared in a quart jar as follows: 3 parts crude oil, 2 parts paraffin oil, 1 part turpentine, 2 parts denatured alcohol, 3 parts water, and 1 part butter of antimony. Add in the order given and slowly beat in the alcohol, water, and butter of antimony with an egg beater. While using, shake well from time to time.

Apply the polish freely to a soft piece of old cotton flannel wrung out of water, and use evenly and quickly on the entire piece. Then clean up with a dry cotton flannel. These cloths should be washed with soap and water after use and put away to dry because they greatly improve with use and washing.

In many cases water rubbing is preferred to oil methods because it is faster, produces a harder, brighter surface, and is cleaner. It requires more skill on account of its cutting speed and should be undertaken cautiously at first. A set of *separate* rubbing equipment is required. The only departure, however, from the standard oil-rubbing practice is the fact that the water-wet cotton waste is dipped into crude oil to rub out the water pumice sludge left on the work as the final rub out.

**I**N RUBBING work in general, disassemble wherever possible, then reassemble for the final clean-up and inspection. In the case of the sideboard illustrated, the door panels were rubbed first; then the top and bottom rails; then the lock and hinge stiles respectively, the strokes being cut sharply across at the joint lines to clear out cross rubbing marks. Next the main body of the sideboard was rubbed out; the drawers taken out and rubbed; the top edge of the drawer front shellacked to prevent sticking; and the runners rubbed with a paraffin block and replaced. Then the top was rubbed. Last of all, the headboard was rubbed and replaced, and the entire case spot rubbed and polished as shown. When one considers that this piece appeared to have been dropped off a truck at high speed when brought in, it will be understood how a careful finishing job will restore furniture to its original color, lovely graining, and beautiful appearance.

It must be borne in mind that there are no short cuts in hand finishing high-grade work. Eternal inspection, vigilance in the manipulation of tools and materials, complete understanding of the processes involved, as well as a sense of good housekeeping—these are the price demanded to produce work in which the finisher can take justifiable pride.

## MICROSCOPE REVEALS FACTS ABOUT MOSS

(Continued from page 49)

which grow up from the protonema strands. After the protonema has started to spread, little swellings appear here and there. These grow into buds which eventually develop into upright stalks from which grow small leaves, pointed and very green. These branches sent up by the hiding protonema are the "moss plants" most people know.

The leaves make interesting objects for microscopic study. They are of relatively simple construction, you will find, and consist of a mass of chlorophyll-filled cells laid side by side, much like the bricks of a pavement. Along the center is a thickened area, composed of compact, thick-walled cells. This probably is a stiffening member, and the forerunner of the elaborate system of veins found in leaves of plants higher in the scale of botanical life than the moss.

**T**HE tips of the leafy branches, or the tips of smaller branches extending from them, develop into rosettelike structures in which are concealed the sexual organs of the moss plant. The male and female organs may be found in separate stems, or on the same stem, depending on the kind of moss.

The male stems, which bear the antheridia, or male organs, usually are smaller than the female. The group of antheridia in the center of the stem is surrounded by a rosette of tiny, green leaves. These rosettes sometimes are called moss flowers, although they are not flowers at all, because the antheridia are yellow or orange-colored. An antheridium, or male sex organ, resembles a tiny club. There is a short stalk, on the tip of which is an oval or nearly oval bulb. This bulbous object is the sperm case, which splits open at the end when the sperm cells inside are to be released.

The female stems, bearing the archegonia, also have a cluster of leaves at their tip, which must be separated with dissecting needles in order to reveal the female organs. Each organ, or archegonium, resembles a tiny, globular bottle with a long neck. Like the male organ, it is made up of numerous cells. In the older archegonia, the necks are open, and there are egg cells in the bulbous bases.

Now, when the sperm cells in the male organ are fully developed, they wait until the moss plant is made wet by a shower or by dew. The water-soaked sperm case bursts open and the tiny sperm cells, each equipped with two cilia or "tails," swim out into the world. These two-tailed sperm cells, which swim about like tiny animals, are distinguishing features of the bryophytes, a group of plants of which moss is the best-known example.

**W**HEN a swimming sperm cell reaches the neck of an archegonium, it makes its way down to the bulbous base, where it joins the egg cell; this produces an oöspore or sexual spore, which starts to grow immediately. The lower part of this oöspore develops into a base or foot, which becomes firmly anchored in the tip of the leafy branch. In fact, the branch grows up about it, holding it securely. Then from the upper part of the oöspore there develops a long, slender filament, on the top of which is the podlike case or capsule in which asexual spores are developed. You can trace the growth of this spore-bearing plant, or sporophyte, by dissecting tips of leafy branches during various stages of its development.

Notice that a hoodlike covering, called the calyptra, forms over the growing sporophyte; and that, as the filament grows upward, it breaks this calyptra loose and carries it upward, where it remains perched on the spore case like a monk's (Continued on page 98)



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## STRANGE FACTS ABOUT MOSS REVEALED BY YOUR MICROSCOPE

(Continued from page 97)

hood, until it falls off. While the typical  
spore-bearing plant consists, as you have dis-  
covered, of a foot, a slender stem, and a spore  
case or capsule, a given specimen may lack  
some of the parts. Sometimes the stem is not  
present, and at other times the foot cannot  
be found. The spore case, however, is always  
there, as it is the important part of this  
phase of the moss plant's life cycle. The  
spores produced in this case germinate to form  
the protonema, and the life cycle is repeated.

**T**O SEE clearly how the moss leads a dou-  
ble life, look again at its life cycle. The  
asexual spores grow into a network of fila-  
ments resembling algae plants. From these  
there rise leafy branches which bear sex or-  
gans. These sex organs join in reproducing an  
oöspore. Thus one chapter in the moss plant's  
history is complete.

Then the oöspore grows into a leafless, cap-  
sule-bearing plant which, without the aid of  
sexual equipment, produces a new collection  
of spores. Here the other personality of the  
moss plant is seen. These asexual spores, when  
they germinate, produce a generation of leafy  
plants.

Note that the leafless growth that develops  
from the oöspore is a distinct, separate plant,  
although it appears to be a continuation of  
the leafy structure. It is entirely separate even  
as far as its activities are concerned, and uses  
the leafy stalk only as an anchorage and  
source of nourishment, much as a parasite  
plant lives on its host. You can observe the  
way in which the sporophyte is held by the  
leafy branch by slicing a number of branches  
with a sharp razor blade until you are lucky  
enough to cut one in exactly the right place  
to reveal the cell arrangement.

The moss plant is a good example of the  
way generations are alternated in the plant  
world. One generation is produced by the  
asexual spore from the spore-producing plant.  
The other is produced by the sexual spore  
from the leafy, sexed plant.

In this complication of structures and ac-  
tivities, you can find much interesting micro-  
scope material. Most of it can be examined as  
simple preparations in water.

To obtain specimens of the algalike growth  
in the field, cut a small cube from a bed of  
moss, going deep enough to include a consider-  
able amount of earth. Place the piece in a  
test tube, fill the tube half full of water, and  
shake it vigorously. Pour out the muddy  
water, refill the tube, and shake it again. Con-  
tinue this until all the earth has been washed  
away. Then place a bit of the green filament  
mass in a drop of clean water, and examine at  
fifty to 350 diameters.

**T**O EXAMINE the entire moss structure—  
the two complete plants—you need only a  
hand lens magnifying seven and a half to ten  
diameters. The green leaves are placed in a  
drop of water and a cover glass is added.  
Their cellular arrangement can be seen at 200  
diameters, and the structures of the individual  
cells, including nuclei, chlorophyll bodies, and  
the like, usually can be seen at 400 diameters.

The tips of the leafy branches, showing the  
male and female organs and the developing  
spore-bearing plant, are examined at moder-  
ate powers. The sexual organs are revealed  
by merely removing the leaves surrounding  
them. The developing oöspore can be drawn  
out with needles and examined separately.

Among the most interesting parts of the  
spore-bearing plant are the spores and the  
capsule in which they were formed. Try to  
find an unopened spore case that still is cov-  
ered by the hoodlike calyptra. Take the cal-  
yptra off, and you will find that the spore  
case has at its tip a caplike structure or lid,

the "dunce cap" already mentioned. This is  
called the operculum. It can be removed  
easily with a needle. You can spend an in-  
teresting ten minutes studying it.

Along with the cap of the spore case you  
frequently can find a ringlike object made  
of a series of cells strung together like the  
beads of a necklace. This usually drops off  
when the cap is removed, and sometimes  
writhes around like a tiny worm, especially  
when it comes in contact with water. The  
opening of the spore case, covered by the  
overlapping teeth, can be studied best if it is  
cut away from the remainder of the case with  
a razor, and mounted so that the teeth show.  
Sometimes it is difficult to make good prepa-  
rations of these teeth from fresh spore cases.  
Try soaking an old, blackened case in water  
or a solution of lye water until it becomes  
softened. Split it open from end to end, and  
mount in water.

**I**T IS fun to grow your own moss under lab-  
oratory conditions. Make a field expedition  
and collect a considerable quantity of moss,  
being sure to get some that is bearing spores.  
This is not at all difficult. Obtain one or more  
shallow flowerpots or similar containers, and  
fill them with earth. To kill fungous material  
that might be present, and would give trouble  
later, place the pot in an oven and bake it for  
two or three hours, at a fairly high tempera-  
ture; or else sterilize it by steaming in a dou-  
ble boiler or similar arrangement for a simi-  
lar length of time. Set the pot in a saucer of  
water, and sow the spores, which you pre-  
viously have pressed out of their cases on a  
clean slide. Jar or blow the spores from the  
glass, so that they fall on the earth. Or hold a  
bunch of ripe spore cases above the pot, and  
jar the spores loose with a needle. Lay a sheet  
of glass over the top of the pot.

The earth will get enough moisture from  
the saucer, to which you must add water  
from time to time. Before long, you will see  
the surface turn green from the growth of  
algalike filaments. In about twenty days, per-  
haps sooner, leafy moss plants will appear.  
These, after a time, will develop sexual organs.

You can control the production of oöspores  
by the way you water your moss garden. As  
long as the plants themselves are not wetted  
directly, but receive moisture only from the  
saucer in which the pot is resting, the egg cells  
will not be visited by the sperm cells, because  
the sperms have to have water in which to  
swim. When you want to raise the second  
generation of moss plants, set the pot in water,  
or otherwise flood it, for two hours. Then  
return it to its saucer, and wait for the spore-  
bearing plants to develop. In this way you  
can control the production of new generations  
of moss, and have on hand material showing,  
at the same time, different degrees of develop-  
ment of the sporophyte.

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that will keep the insects away from outdoor  
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been announced by scientists of the New Jer-  
sey Agricultural Experiment Station. A power  
sprayer is used to scatter the liquid as a fog  
over grass, ground, and shrubs, half an hour  
before the assemblage is to take place, and it  
is declared effective against both common and  
salt-water mosquitoes. The formula includes  
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## NEW WONDERS PROMISED BY SHORT-WAVE RADIO

(Continued from page 11)

equals 1,400,000. So, 1,400,000 impulses have to be amplified, sent through the ether and picked up by a perfectly synchronized receiver while the clock is ticking once. Engineers predict that if the large-scale test now under way proves successful, television receivers can be put upon the market for approximately double the cost of a high-class radio receiver.

Images produced by the latest television sets are so clear that in street scenes it is possible to read the license numbers on passing automobiles, and in football games, the numbers on the players' sweaters. As many as thirty pictures a second have been transmitted and received in laboratory tests, thus producing steady movement without the slightest blur or flicker.

WHILE television is undergoing its \$1,000,000 field test in the United States, public sight-and-sound broadcasts are starting in England on seven-meter waves from a studio in the Crystal Palace at London. So far, the programs have been rebroadcast from sound films. Receivers as far as twenty-five miles away have picked up the images in brilliant black and white. Viewing screens on these English receivers are six inches wide and eight inches long.

A few months ago, an American expert estimated that in nearly half the area of the United States static becomes so bad on stormy nights that listeners have to switch off their radios. Only near the powerful major stations which center about large cities can the programs cut through the electrical disturbances. The conquest of static stands high on the radio engineer's list of things to do.

The latest advance toward the goal is reported from New York. For more than a year, Major Edwin H. Armstrong, radio pioneer and Columbia University professor of electrical engineering, has been sending out programs on stormy nights to test a staticproof, nonfading system of radio transmission he has invented. The programs are recorded on disks at the receiving stations. Even during thunderstorms so severe that the big commercial stations were drowned out by crashing static, the Armstrong broadcasts came through without interruption. In one case, a receiver eighty-five miles away picked up the program. Through another storm, Armstrong sent a facsimile copy of the front page of a newspaper. It reached its destination without the least blurring of the print, so well was the static eliminated.

The secret of Armstrong's invention lies in introducing into the radio waves a characteristic which is not found in the natural waves of static. The receivers are designed to pick up only these "earmarked" waves and are not sensitive to static. A difficulty lies in the way of wide adoption of the Armstrong system, however. It would require scrapping present-day broadcasting and receiving equipment and replacing it with apparatus of new design.

FROM a different angle, Andrew Ring, chief engineer of the Federal Communications Commission, has been attacking the static problem. He proposes a chain of superstations, each with a power of at least 500,000 watts, to cut through static and reach the rural listener. Only one such station is now in existence, the \$500,000 experimental WLW put up by Powell Crosley, Jr., at Cincinnati, O.

On the outskirts of Philadelphia, Pa., as this is written, workmen are putting the finishing touches on a 100-mile cable of revolutionary design. It will link New York and Philadelphia in a service with possibilities not only for telephone, (Continued on page 100)

# INVENTORS

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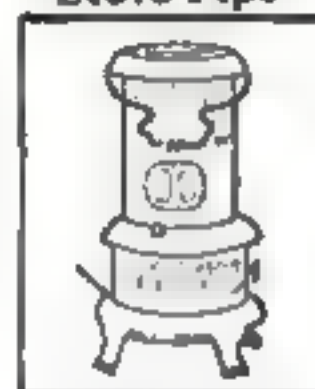
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## NEW WONDERS PROMISED BY RADIO

(Continued from page 99)

telegraph, radio, and teletype, but for television as well.

Developed by experts of the Bell Telephone Laboratories, in New York, and named the "coaxial" cable, it has shown amazing possibilities in recent tests. It can carry 200 telephone calls simultaneously. The best that is possible with present equipment is four conversations. If used for telegraph work, the new conductor can transmit 2,000 messages at the same time. Besides this, it can accommodate a million-cycle wave band and so can be employed for piping television images from one broadcasting station to another.

Only seven eighths of an inch thick and sheathed in lead, the 100-mile cable contains twin copper tubes and eight paper-insulated wires. The tubes are filled with nitrogen gas and a central wire runs through them, supported by rubber-disk insulators.

**BOTH** the wire and the inside of the copper tube act as conductors, and each tube carries messages in only one direction. Specially designed booster mechanisms which function automatically are being placed at ten-mile intervals to overcome transmission losses. One sensational application of the new cable has been suggested by engineers. It may make it possible for us to see the person with whom we talk by telephone!

Contrast with that modern possibility a report from Paris, France. On the highest point in the city, the government is reconstructing an immense semaphore which stood on the eminence in the days of Napoleon.

It formed a link in a communication system that was a crude predecessor of the telegraph. For hundreds of miles across France, lines of such semaphores wigwagged messages by a modification of the army flag code. In half a day, the semaphore telegraph carried news of a French victory in Alsace 250 miles to Paris. Amazement at this speed of transmission rivaled excitement over the victory.

Now, not much more than a century later, we are talking in terms of television, facsimile transmission of newspapers, superpower stations. Nor, is that all. Even more amazing advances may lie just beyond the horizon, and in a relatively short space of time we may find ourselves surrounded by marvels that now seem as impossible to us as the telephone and airplane must have seemed to people who were living less than a hundred years ago.

In addressing engineering students at Princeton University, not long ago, General James G. Harbord, chairman of the board of the Radio Corporation of America, pointed out that it is within the realm of possibility that aromas and flavors can be sent across the ether just as sounds and sights are transmitted today!

**THEN**, it would be possible to taste a peach or smell a rose from a place a thousand miles away. You might even take a trip around the world by proxy, seeing the sights, hearing the sounds, smelling the odors, and even tasting the fruits and dishes of far-away lands, without ever stirring from your easy chair!

## AMATEURS HELP MAP THE UNIVERSE

(Continued from page 23)

Association of Variable-Star Observers also maintains a circulating library of astronomical books and a fine set of lantern slides for lecture purposes, and telescopes are often lent to members. Dr. Harlow Shapley, director of the Observatory, is the current president, while Dr. Leon Campbell, his associate, is the recorder.

For the observer without a telescope, meteor hunting offers a rich field of activity. Incredible as it may seem, millions of meteors enter the earth's atmosphere daily, some of them no larger than grains of sand and others large enough to light up the sky in broad daylight. All are believed to be fragments of disintegrated comets or other celestial bodies, and a determination of the brightness and a plotting of the direction of fall of meteors is a great clue in ascertaining the nature of the catastrophe that may have caused them.

**ALTHOUGH** most meteor hunting is done visually, many enterprising amateurs are now using cameras with high-speed lenses to record meteor trails. These photographs are especially valuable, as they form a permanent record for reference. In hundreds of thousands of star plates made by regular observatories, only a few hundred meteor trails have been caught. Here is a new and difficult sport for the amateur.

The American Meteor Society, under the leadership of Prof. Charles P. Olivier, with headquarters at the Flower Observatory of the University of Pennsylvania, Philadelphia, Pa., directs the efforts of several hundred amateur observers, and new recruits are always welcome.

Besides these national organizations, more than fifty local clubs have been founded throughout the country for the aid and stimulation of amateur work. A number are spon-

sored directly by scientific societies, universities, or observatories. Perhaps the largest is the Amateur Astronomers' Association, with more than 600 members, which meets twice a month at the American Museum of Natural History, in New York City. This organization also conducts a junior astronomers' group, in addition to holding classes in astronomical theory, observing, and telescope making.

Apart from those broad fields in which hundreds of amateurs cooperate toward a common end, many amateurs have developed specialties in which they have become particularly efficient.

Dr. William H. Stevenson, an English physician, keeps a record of the fluctuations of new stars, of which there are about a dozen. He has a twenty-inch telescope and was formerly president of the British Astronomical Association. William Henry, a Brooklyn, N. Y., photographer, is noted for his sun-spot pictures. On every clear day for five consecutive years, Henry took a small telescope and reflex camera into his back yard, set them up on an improvised stand, and "shot" the sun. As a result, this ardent amateur has one of the finest collections of sun-spot pictures in the country.

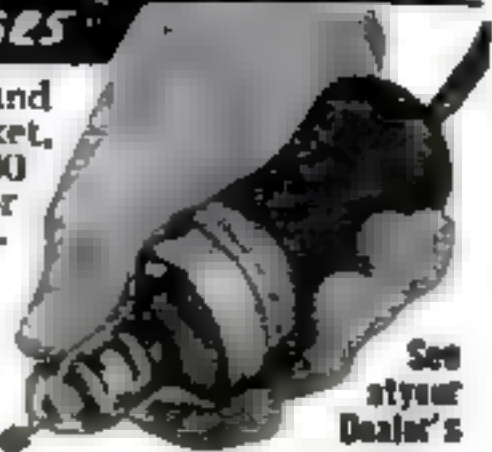
**FRIENDS** of Charles W. Elmer, head of the astronomy department of the Brooklyn Institute of Arts and Sciences and vice-president of the American Society of Variable-Star Observers, would insist that the chief specialty of this amateur is saturating the uninitiated with his own whole-hearted love of the stars. As second choice, they would readily agree that he has taken some of the best photographs of star fields ever made outside a professional observatory.

Leslie C. Peltier, besides being one of the most active (Continued on page 101)

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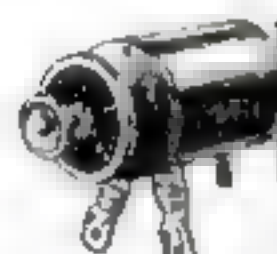


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## AMATEUR STARGAZERS HELP MAP THE UNIVERSE

(Continued from page 100)

variable-star observers in the world, hunts deliberately for comets and new stars. In these searches he works systematically, dividing the sky into bands and sweeping these bands slowly and painstakingly with a special short-focus telescope lent him by Princeton University. Thus far, this thirty-six-year-old astronomer has made more than 47,000 observations and has the discovery of several comets and new stars to his credit.

A SURVEY of typical amateur equipment used for serious astronomical work shows an amazing range of cost, beginning at almost nothing and running at the very peak into tens of thousands of dollars. At one end of the scale we find such instruments as the famous "coal-scuttle" telescope built by Henry Kramer, of Detroit, Mich.—an astonishing reflecting telescope, mounted equatorially by means of a galvanized-iron bucket, gas pipe, assorted timbers, the stump of an apple tree, and a weighted paint can. An instrument of this kind could be made complete for less than five dollars. More elaborate reflecting telescopes, of six-inch aperture, could be built for twenty-five to fifty dollars.

At the other extreme we find a few complete observatories, equipped as adequately as some of the best professional observatories in the world. An outstanding example is the observatory of Gustavus Wynne Cook, Philadelphia banker and manufacturer, set up on his estate at Wynnwood, Pa. Here, because of building restrictions, a little cottage supplants the dome of the typical observatory.

Chief among the instruments is a twenty-eight and one-half-inch reflector, hung in an open-fork mounting similar to that of the sixty-inch telescope at Mt. Wilson. The tube is of duralumin and is swung by electric motors on polar and declination axes mounted on roller bearings. Attached to the tube is an eight-inch refracting telescope, as well as a six-inch finder. A full battery of accessories permits the use of the telescope for practically all phases of observation—including work with a large spectroscope which reveals the chemical composition of distant stars. Photography of the moon is accomplished by a camera of Cook's own design and construction, the exposure being graduated by a sliding shutter in proportion to the relative brightness of the different parts of the moon's surface.

NO RECORD of amateur astronomical work in the United States would be complete without mention of the McMath-Hulbert solar tower, at Pontiac, Mich., just opened as an official observatory unit of the University of Michigan.

Nearly ten years ago, Francis C. McMath, a retired bridge builder, his son Robert, president of a metal-stamping company, and Henry S. Hulbert, a former judge and now vice-president of a Detroit bank, decided it was high time to make not only still but moving pictures of the sun, moon, and stars. Only pictures in motion could record satisfactorily the wonders of stars eclipsing each other, the terrific hydrogen explosions on the sun, and the shadows creeping over the moon.

The new solar tower, designed and built almost entirely by these amateur craftsmen and astronomers, stands nearly fifty feet high and reflects the sun's image into a camera, or other instrument, in a pit beneath the tower, by means of moving mirrors. There are only two other solar towers in the United States—both at the Mt. Wilson Observatory—and three more in the whole world. And, according to good authority, this tower, built and operated by amateurs, is the most efficient of them all.

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## NEW BANK VAULTS DEFY THE CRACKSMAN

(Continued from page 39)

morning, the time locks run down, permitting the combination locks that control the bolting mechanism of the doors to be operated, and the doors to be opened. Vault doors in large banks employ a pair of combination locks that must be worked by two men, each one of whom knows only one of the combinations.

Everyone has read of the crook with such sensitive fingers that he could open a combination lock by "feel" alone. Sometimes he was supposed to file or sandpaper his finger tips to make them more acute in their touch on a dial.

SUCH "Jimmy Valentines" don't exist any longer, for the simple reason that combination locks are not what they used to be. Time was when the mechanism operated under a spring tension and the criminal was working against this tension when he turned the dial on the lock.

The modern combination lock does not have this tension, the lockpicker cannot "feel" the tumblers falling into place when the proper number is dialed, and he could sandpaper his fingers to the bone with no result. The filing of the fingers was a myth anyhow, evolved by fiction writers, although crooks who took advantage of their supersensitive finger tips did actually exist.

If a cracksmen tries to drill or burn his way through the enormous plug of steel that constitutes a vault door, he faces forty-eight inches or so of the toughest metals that science has devised. One manufacturer adds, for good measure, a layer of chemicals that give off choking fumes of tear gas when subjected to the heat of a torch. And modern vault doors are so perfectly fitted that there is no crack through which nitroglycerin could be poured. When closed, the doors are watertight.

Why all the emphasis on the vault doors rather than the walls of the vault?

There is a good reason. It is desirable to have strong walls, but much more important to have powerful doors. A hole in the door the size of a pencil, if at the right location, can permit an expert crook to work the bolting mechanism; but in the vault wall proper it is necessary to cut a hole the size of a man before any harm can be done.

To make the task as hard as possible, concrete is poured around an interlaced webbing of tough steel bars to make the walls, floor, and ceiling, which may be as thick as fifty-four inches. The lining of the vault proper, within this shell, consists of multiple layers of torch, drill, and explosion-resisting steel, and sometimes a layer of the tear-gas chemical already mentioned.

THIS strong room is the heart of any banking institution. No matter how large the bank building, it is a mere shell literally built around the vault. When a bank is constructed, the vault is made first as a separate unit so that any disaster to the building will leave it untouched. A flood could swirl over a modern vault, ripping away the building, or fire could ravage the structure that covers it; but the contents of the vault would be unmolested and unharmed.

Since even the most formidable walls will not stop the boldest criminals, most large vaults today employ automatic electric alarm systems to deal a final blow to the criminal's hopes of entering.

Two distinct types of electric protection, which may be used separately or in combination, have proven so successful that the makers boast that no vault protected by either system has ever been looted. One system employs electrical cables embedded in the vault wall, in a complicated pattern that

makes it impossible to penetrate the masonry without coming in contact with them. If a single wire of the network is broken or short-circuited, an alarm is sounded. The second type, employing sensitive microphones, is actuated by the sound of hammering, drilling, or explosions. A clanging gong on the exterior of the bank building may give the alarm signal, or the system may be wired to the central-station switchboard of a private protective company, which, in turn, notifies the police.

EXPERIENCED vault breakers are too clever to attempt to loot a bank vault protected not only by thick masses of concrete and steel but also by a foolproof alarm system. Beginners at the game, however, still take the long chance.

Not long ago, a gang of cracksmen spent four months tunneling into the vault of a Chicago bank. By sheer luck a bank employee made an unscheduled visit to the vault on a holiday, discovering the attempted burglary before the thieves could complete the job and remove the money.

Just recently, the manager of a suburban bank near New York City raced to the bank one Sunday afternoon when he learned that an alarm had come in to the central station. With the police and private guards already assembled there, he examined the premises from top to bottom. Not a sign of burglary was discovered. Muttering something about "unnecessary false alarms" he called off the search.

Five days later, the bank janitor tried to sweep up an oily rag lying on the concrete floor of the pump room next to the vault. It stuck to the floor. He tugged at it energetically and found that it had been stuffed down into a long hole slightly larger than a broom handle. He immediately got in touch with the manager.

Once more the police authorities assembled. Rats certainly could not have nibbled that hole through the concrete. Detectives decided that it had not been drilled downward from the pump room floor but up from underneath. Tunneling!

A thorough search of the neighborhood revealed that some men who had planned to open a store two doors away from the bank had suddenly given up the idea. Police tried to locate them but they had left town the Sunday before.

Down into the cellar of that abandoned store went the police. They found large packing boxes full of fresh dirt. Finally they located a tunnel, five feet high and three feet wide, leading directly to the wall of the vault. The gang had evidently burrowed through to the bank wall, probed with a steel rod, and made the mistake of holing through the pump-room floor.

AS DETECTIVES reconstructed the story, one of the "store proprietors" who had rented a safe-deposit box in the bank entered the bank the following day, stuffed the rag down the hole, and calmly went back to his tunnel. On Sunday afternoon another probe had penetrated into the vault wall, made sufficient noise to actuate the sound detectors, and set off the alarm.

It must have been a cool-headed gang. Over the front window of their projected "remnant store" they had stretched a wide banner which read: "Watch for the Big Opening!"

Modern bank vaults, however, are no longer subject to unscheduled "openings." Science, by developing and perfecting new weapons in steel and stone and electricity, has finally won the long and hard-fought battle with the vault burglar.

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## PRESERVING SPECIMENS IN PICKLE-JAR MUSEUMS

(Continued from page 51)

of forty-five percent formaldehyde. Add two and one half cubic centimeters each of pure glycerin and glacial acetic acid. To the resulting solution add ten grams of copper chloride and one and one half grams of uranum nitrate.

The leaves should be placed in this solution and left for from three to ten days. In this time they are usually thoroughly preserved and may be removed and kept in a four-percent formaldehyde solution or they may be dried, pressed, and mounted on paper.

Fruits, flowers, and fleshy growths are difficult to preserve nicely, but a four-percent solution of formaldehyde to which pure cane sugar has been added gives fair results. Experimentation is necessary, however, to determine the amount of sugar to use with different specimens. Incidentally, there is a field open to the experimenter who can solve the problem of displaying flowers and fruits preserved in full, natural color, as such displays would be much in demand for advertising and other commercial work.

THE only solution known to the author so far that is of any value in this connection is prepared as follows: To 4,000 cubic centimeters of hot distilled water, add 200 grams of zinc chloride. Dissolve this and filter the solution. Now add 100 cubic centimeters of forty-percent formaldehyde and 100 cubic centimeters of pure glycerin. When this solution cools, filter again if it is not clear. This formula will preserve the green and red coloring in apples, and experimentation may prove it useful for other things also.

The next time you find some freakish creature or plant, try these simple preserving solutions. You'll be surprised how quickly you will be able to build up a really professional "pickle-jar museum."

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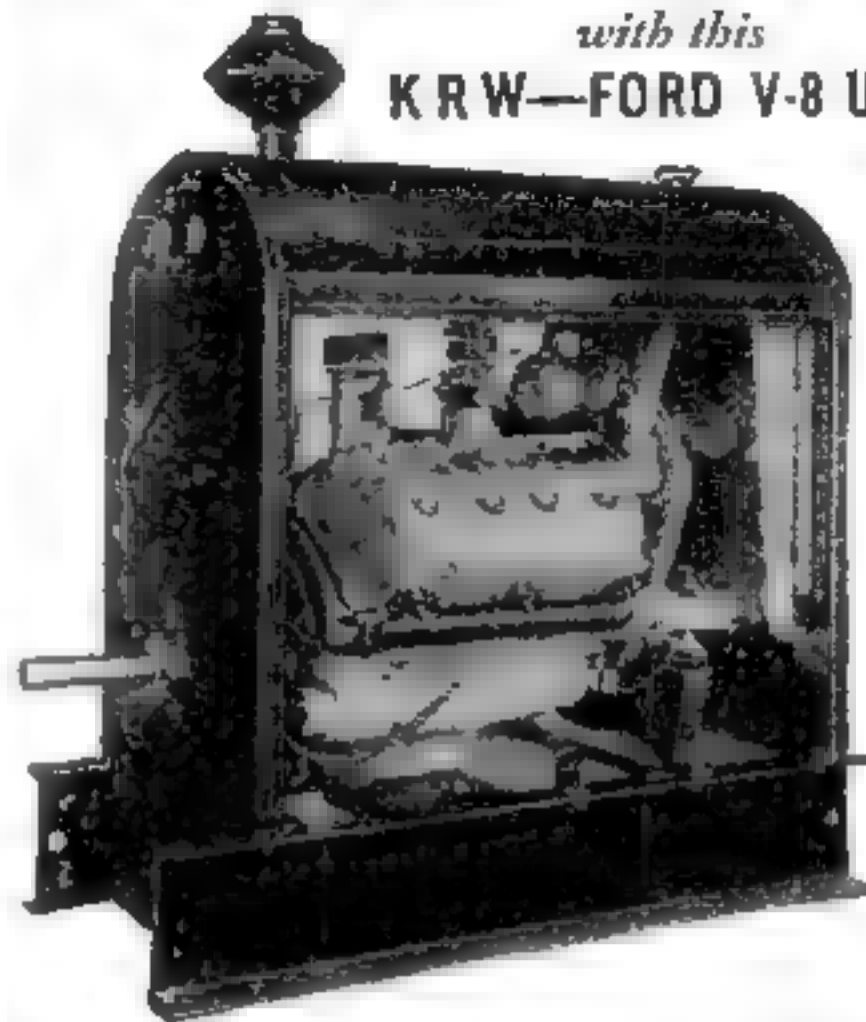
LARGE doses of atropine, a poisonous extract of belladonna and nightshade, are reported as a new cure for seasickness by two Rumanian physicians. Ordinarily, large doses of this alkaloid would be extremely dangerous or even fatal, but, working on the theory that some poisons tend to make the whole nervous system less irritable, the physicians suggested that such doses of atropine could be used for seasickness. Some measure of success has been attained by giving large doses of this poisonous drug to aid victims of infantile paralysis. Such treatment has also been tried out for other types of illness, such as asthma and the condition due to an overactive thyroid gland.

## NEW GUINEA MUMMIES "EMBALMED" BY NATURE

A MYSTERIOUS group of human mummies found sitting in a long cave in the Morabe gold-field district of New Guinea were preserved by nature and not by man, according to British scientists. Although when first found the bodies appeared to have been embalmed, further investigation indicated that they were actually dried up. It is believed that conditions in the limestone cave, which was high above sea level, served to dehydrate the bodies, thus preserving them. These later discoveries have apparently upset the earlier belief that natives of New Guinea once knew how to mummify bodies as did the Egyptians, and perhaps had learned the art from distant Egypt. More than sixty light-skinned corpses were found in the cave with their knees drawn up to their chins.

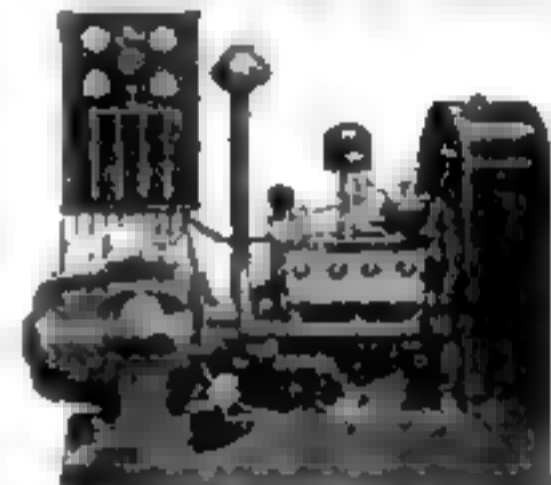
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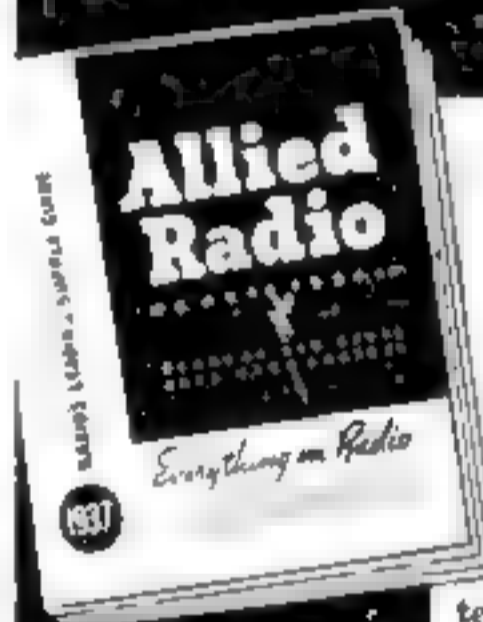
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## MORE \$5 PRIZE WINNERS

Two prize winning letters in POPULAR SCIENCE MONTHLY'S new Secrets of Success contest—"What Home Study Has Meant to Me"—are printed below. Read these stories carefully because your own career may be just as interesting and inspiring to other readers. If you think so, put it down on paper and send it in. We will pay \$5 for every letter we publish.

### CONTEST RULES

Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 750 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

## SAFEST ESCAPE FROM UNCONGENIAL WORK

Since my tenth birthday when I received a tiny box camera, I have been an incurable camera crank. It was only natural, then, that as I grew older and acquired a family which my weekly pay check did not adequately provide for, I should try to turn my hobby into hard cash.

I say "tried" advisedly for that was all I did for many a month. Oh, I took many, many pictures (good ones, I thought) but for some reason or another they failed to find editorial acceptance.

About two years ago I saw the ad of a correspondence course in photography and decided to investigate it. To make a long story short, I took the course and have never regretted it since.

Painstakingly the school graded my work, showed me my errors, and taught me how to take pictures that sell. I hadn't been studying long before I learned why my previous pictures hadn't sold, good as they were. Photographic journalism, as all other professions, has certain fundamentals to be mastered, without which the beginner is enormously handicapped.

Pictures that are just good will never sell. They must tell stories; must have

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## Secrets of Success

interest-awakening angles, must present a problem or answer a question. It was only after taking the course that I learned to recognize these essential factors. Even before I had finished my course, the school helped me to market enough photos to pay more than half of my tuition.

This course, which cost less than fifty dollars, has enabled me to add from five to twenty dollars extra to my income every week. It financed two vacations, one to Mexico. And I feel that at any time I can leave my regular job and make a good living just taking pictures.

Now I am planning to take a home study course in writing and when I have finished this I am going around the world, financed entirely by my writing and photography. A real incentive!

I want to say to the many ambitious men—and women, too—engaged in uncongenial work that the home study route offers perhaps the safest way out known. It reduces to the minimum any time and money lost in switching from one line of endeavor to another.

—J.A., El Paso, Texas

## EMPLOYERS EAGER TO HELP HOME STUDENTS

A happy and successful man is generally one who is living some of the dreams of his youth; a man who earns an ample income through the work of his own choosing.

Each year many boys in their middle teens leave school, either through economic necessity or by free choice, to enlist in that tragic army of young unskilled workers. Like the ball in a marble machine they start with a rush of youthful energy, bouncing from peg to peg for a short time only to fall into some hole by the mere chance of fate. Young men, beaten and aged at thirty; doing work for which they are ill-fitted and expressing an intense hatred for their sad position with a constant cry of ill fortune.

Home study can furnish sound training to a young man who really wants it either in line with his immediate work or in a totally different field.

I reached the age of fifteen a husky six-footer with a liking for football, baseball, hunting and fishing; just an ordinary kid. I did, however, have an ambition to build things and to travel in the world of men.

One hot July day I took a long look at the summer haze against the California foothills, tossed my hayfork into the nearest shock, collected my wages and started out to see what made the old world click. It was a glorious summer. I worked on a railroad in Montana unloading heavy bridge timbers; in Washington, I loaded fruit, and in the early Fall I finally loaded myself on top of a California-bound box car for home.

I arrived there full of enthusiasm. I had discovered what made the wheels go round. In those several months I discovered that the men who did the clicking in my kind of world could do things with their heads that my muscles couldn't. They worked with intricate machines and tools, with levels and transits, and they

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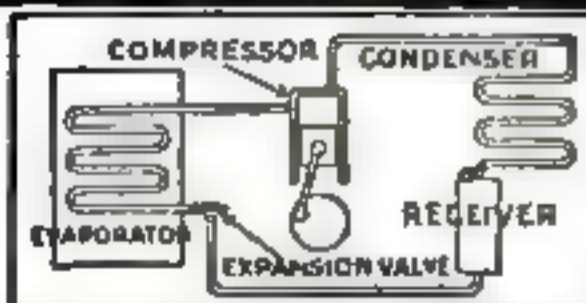
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## Secrets of Success

spoke a picture language of blueprints.

But the news at home took the wind out of my sails. The folks had met with adverse fortune that summer. There was a large family of us, Dad needed help and I was the eldest boy. My parents felt very badly about my leaving school and begged me to study at home. I thought it a splendid idea and borrowed \$10 to enroll in my first home-study course—a course in drafting with the School. I then secured a job driving a team hauling gravel.

Six months after my seventeenth birthday and after only one day's surveying experience, I had a job as transitman with a surveying party. In a few months I was in charge of a survey party on the construction of a tunnel in the high Sierras. At nineteen I was building canals and hydraulic structures along the Mexican border and at twenty-one I was an assistant engineer in the tropics.

Since then I have worked on dams, bridges, buildings, pipe lines and other construction, both in the field and in the office. I am not eminent in my field nor am I wealthy, but I am happy. I am doing the kind of work that I would rather do than anything else on earth. My income is ample to supply the needs of my family and I have never been out of a job in seventeen years.

I have worked for numerous organizations and without exception I have found the men higher up eager to help any young man who is willing to help himself through home study.

Home study develops the ability to learn much about any subject through observation and reading. Sometime ago I discovered that I had unconsciously developed—to a certain degree—an analytical viewpoint and the ability to express myself in writing on subjects quite foreign to my work to the extent that several of my contributions have been accepted for publication.

My hobby is the realization of one of my most potent boyhood dreams—a home workshop. The present availability of quality machines and tools at possible prices has made many of us grown-up, mechanically-minded kids very happy.

—G.L.L., Sacramento, Calif.

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THE bobbin winder on an ordinary sewing machine can be utilized as a miniature lathe for making belaying pins, wheel housings, capstans, and other small turned fittings for model ships.

Cut a dowel to the proper length. Insert a common pin in one end after cutting off the shank so as to leave about 3/16 in. to press into the wood. Round off the other end of the dowel to fit into the bobbin winder. Work the sewing machine in the usual manner as if threading a bobbin, but with the dowel in place of the bobbin. Use small chisels and files. For very clear, sharp lines, I have found a broken piece of glass is excellent. Numerous little fixtures that are needed in model work can be turned in a few minutes by this method.—D. E. KENNY.

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## DEADLY MAGNETIC RAYS AID WAR ON CANCER

(Continued from page 13)

particles travel in an ever-widening spiral, constrained by the magnet to follow a roughly circular path, while two charged electric plates take turns in boosting their speed with 50,000-volt kicks at each half revolution. By the time they reach the rim of the pill box, the atomic bullets are moving at the almost incredible speed of 12,000 or more miles a second! Through his ingenious scheme of prodding the speeding projectiles in his atomic whirligig with several hundred successive kicks of comparatively low voltage, Professor Lawrence obtains a beam that could be duplicated only by the application of millions of volts to a conventional vacuum tube.

TO EXPOSE objects to the ray, it was originally necessary to place them within the pill box. Recent improvements in the apparatus have made it possible for the first time to bring a 6,000,000-volt beam of heavy-hydrogen particles right out into the open air. Now scientists can see with their own eyes the marvel of a beam of radiation more than five times as powerful as any that has ever been produced before—even in a vacuum tube, where collisions with air particles do not slow down the high-speed particles. And being able to work in the open with the ray has permitted fascinating new tests of its powers.

When the cyclotron's greenish-blue beam is shot against a target of beryllium metal, powerful "secondary" or recoil radiations stream forth—much as X rays are produced when a cathode-ray beam of speeding electrons is trained upon a metal target in an X-ray tube. The rays from the cyclotron beam's impact, however, are far more penetrating than X rays. They are believed to be streams of atomic particles of a recently discovered sort known as "neutrons," produced by the mutual shattering of the particles composing the cyclotron beam and of the atoms of the metal target. No known shield will stop them completely. They pass through the thickest walls of metal as sunlight pours through a window. Tanks of water, which slow the rays down, have proved the best barrier.

So deadly a menace are the neutron rays, the by-products of the magnetic-ray gun's luminous beam, that the University of California experimenters have issued a warning to research workers in other laboratories where cyclotrons are now being built. Lack of protective screening to shield laboratory workers from the rays, it is pointed out, might easily cause a series of tragedies such as followed the discovery of X rays, in the late 1890's, before the danger of injurious or fatal "burns" was realized.

TESTS with 200 mice have shown the rays to be nearly three times as destructive as X rays to healthy tissue. The same tests, however, indicated that the rays were four times as destructive as X rays to unhealthy tissue, as represented by a certain type of cancerlike tumor in mice. In this significant difference lies the hope of applying the rays to the treatment of human cancer.

Two powerful weapons now used against cancer—radium, and its modern rival, high-voltage X rays—both provide deeply penetrating rays that attack human tissue selectively, destroying malignant tumors and leaving normal tissue unharmed. Often, however, it is impossible to give a large-enough dose of rays to kill the malignant growth without harming the patient. The best that can be done at present with X rays is to cure or benefit about fifteen percent of the patients treated—barely one out of six! Far more sufferers could be relieved if some kind of radiation relatively (Continued on page 108)



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# MAGNETIC RAYS AID WAR ON CANCER

(Continued from page 107)

more lethal for cancerous than for healthy tissue could be found. Neutron rays appear to be just such an agent. Some way must be found of directing them just where they are wanted and of controlling their power within limits that the human body can stand—and this is what experimenters are now seeking to do. Cautious as scientists habitually are in promising medical advances, workers with the cyclotron ray cannot conceal their enthusiasm for its possibilities.

**A**RTIFICIAL radium, successfully manufactured with the cyclotron and expected to be made available to hospitals before many months, is already being hailed as a boon to medicine. It is the radioactive product obtained when salts of sodium, calcium, magnesium, boron, and a host of other elements are exposed to the magic ray. The salts retain their radioactivity for a limited time, varying from a few seconds to several months according to the particular substance used, but this is not regarded as a handicap. In fact, it may prove an actual advantage, since it has been suggested that a measured quantity of the man-made product might be injected directly into the part of the body to be treated and left there, automatically becoming harmless and preventing an overdose of rays after the desired time of exposure.

These substitutes may have a telling effect on the demand for radium. At one time, when radioactive ores of Colorado were the principal source of supply, the standard price was \$100,000 a gram—or about \$3,000,000 an ounce. Then rich radium deposits were discovered in the Belgian Congo, and low production costs dropped the price to \$60,000 and later to \$40,000 a gram. Meanwhile, the supremacy of radium has been threatened, first by superpowerful X rays and now by cyclotron rays and the artificial radium they produce. The price of the natural element seems due for another slump, and it is reported that if anyone wants a dozen grams or so of radium they can be obtained for about \$15,000 a gram.

More than a third of all the known chemical elements have been changed into different substances by exposure to the beam from the cyclotron. Some of the products, like artificial radium, are new to science. Other transformations are no less startling, even though the products are familiar. Platinum, for example, has been turned into gold—not in quantities large enough to cause any flurry at the United States Treasury, but none the less pure gold.

**N**ATURALLY, it would be hard to interest any sensible person in converting platinum to gold as a commercial proposition. Physicists are excited about the feat, however, because it verifies present-day theories of the structure of atoms. The two precious metals are next-door neighbors in the list of chemical elements, their atoms supposedly differing only slightly in mass and constitution. By adding "building blocks" in the form of neutrons to atoms of platinum, and letting the impact shake them up and rearrange the internal structure a little, the experimenters have produced atoms of gold and shown that their theories can be put into practice. Atoms of every one of the ninety-two known elements, they believe, are simply differently arranged combinations of a very few fundamental materials—electrons, protons, neutrons, and perhaps one or two others. Now they are learning how to take these combinations apart and reassemble them to obtain any substance they want.

One group of would-be atom smashers has attacked the problem with electrical genera-

tors that apply staggering voltages, sometimes running into the millions, to vacuum tubes. The largest of these, erected by the Massachusetts Institute of Technology, requires a dirigible hangar to house it and hurls the force of 10,000,000 volts between two fifteen-foot aluminum spheres mounted on railway tracks. A handicap of apparatus of this type is that electricity of such enormous voltage tends to leak off into the air, sapping the generator's power, and ingenious means have been devised in an attempt to overcome the difficulty.

**U**NIVERSITY OF WISCONSIN experimenters have just placed in service a compact counterpart of the M. I. T. monster, which incloses a high-voltage generator in a steel tank filled with air under a pressure of 100 pounds to the square inch. The high pressure prevents electricity from escaping as a whirling rubber belt piles up a charge of a quarter of a million volts on a cylindrical metal shell with turned-in ends. This voltage, applied to a tubular "gun" that actually resembles a giant rifle in shape, produces "positive rays" or streams of atomic bullets of tremendous power. With their aid, the operators of the machine have already effected transmutations of elements, obtained neutron rays, and performed experiments that add to the hope of applying the new type of radiation as a weapon against cancer.

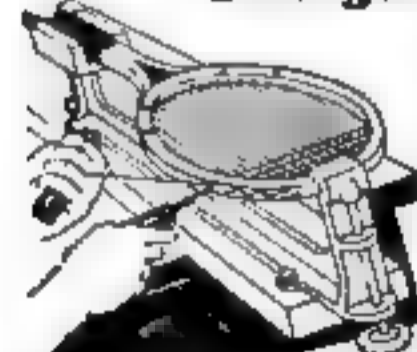
In contrast with these machines, the cyclotron developed by Professor Lawrence uses only a modest voltage, yet workers with it have obtained the most spectacular results so far reported in the atom-smashing field. How great an advance its rays represent over those of naturally radioactive substances like radium is easily demonstrated with the aid of a scientific instrument called a cloud chamber, which makes visible the trails of speeding atoms after collision with the flying particles. The disturbance produced in a cloud chamber placed six feet from the cyclotron is as great as could be obtained from 100 grams of radium, or \$4,000,000 worth. Alterations now under way will increase the power of the University of California cyclotron still further, and its rays will be harnessed more effectively by a huge vacuum tube that experimenters are planning to attach to the machine.

This constant advance in the power of atom-smashing tools promises that one of these days we may look for the transmutation of elements in test tubes and flasks, perhaps eventually in industrial tanks and vats, instead of on a submicroscopic scale. Will we turn our unwanted copper into zinc, or meet a shortage of sulphur by making it from phosphorus? The idea seems much less fantastic than it did only a few years ago.

**P**ROSPECTS like these are foreshadowed by the giant atomic-ray gun and its luminous beam. Some of them are only hopes, so far, but scientists the world over are working to turn them into facts. As this is written, seventeen research centers are building or planning cyclotrons patterned after the University of California machine. Ten of the devices will be in the United States. One of the largest, at Princeton University, will consume as much electric power as a large metropolitan broadcasting station, and breastworks of earth as well as tanks of water will shield the operators from its deadly rays. An installation at the University of Michigan, employing a ninety-five-ton electromagnet, will outrank even the California apparatus in power. Science has been waiting for just such a tool as the cyclotron, and now it is going to make the most of it.

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(Continued from page 33)

stalks or leaves. This is essential, for through the green leaves, the tiny plants manufacture their own food.

When the wheat attains an average height of two and a half inches, Dr. Davis carefully selects several score plants, all within a quarter inch of the same height, for transplanting. Since the principal function of soil has been found to be supporting plants in an upright position, these are placed in ordinary bottle corks fitted into a frame, each cork supporting the stalk of one plant. Room for expansion is provided by making the holes extra large and packing cotton around the stalks.

**FROM** this point on, in addition to controlling nutrition and temperature of the roots, Dr. Davis also controls every factor influencing the tops of the plants. He may provide Alpine conditions by creating low temperature and high humidity at one time, only to switch to the desert by combining high temperature and low humidity later, or bring in the tropics with high temperature and high humidity. Further, he may supply water to the roots at one temperature and air to the tops at another.

"In nature," he commented, "the roots are usually colder than the tops. We have seen striking changes in this wheat by lowering the root temperature to ten degrees, while holding the air at twenty degrees. Lowered root temperature, we have found, increases the sugar content of the root, and this tends to develop a hardier, sturdier plant."

As I stood looking at the large glass box, Dr. Davis demonstrated how he changes the weather at will. Into the case a stream of freshly washed air was being blown by fans, the moisture content kept constant automatically.

Stepping to the near-by controls, the scientist closed one valve and opened another. As I observed two instruments, I noticed that the temperature and humidity were rising. The dry, arctic cold was becoming a moist, tropical heat before my eyes.

"Likewise," the scientist explained, "the composition of the air may be changed by adding or subtracting oxygen, carbon dioxide, or any of the other gases the air ordinarily contains."

Then, as I looked on, red imitation sunlight suddenly bathed the cork-bedded wheat.

"Why red?" I inquired.

"Sunlight, we know, is made up of rays of different wave lengths," Dr. Davis explained, "and their colors range from the long, red variety to the short violet. Science has known for a long time that plants need red and blue light, while yellow and green are less important. Until recently, little had been learned of the relative importance of red and blue and of the rôles they play in the growth and composition of plants."

"For that reason, we have provided our plants with red 'suns' and blue 'suns' and we have found striking differences in plants grown under the two conditions. For example, we have found that wheat deprived of blue light became long and spindling, like children with rickets. Plants deprived of red light become dwarfed in size and they are likely to die prematurely."

**NOR** were different colors alone responsible for some outstanding results. Tests have shown that a change in the length of day, with the "suns" shining at constant intensity, has a different effect than merely changing intensity. The wheat, for example, grew more rapidly in more intense light; but when it was exposed for longer times, the sunlight had an even greater effect! This is thought to account for the (Continued on page 110)



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# NATURE'S SECRETS REVEALED

## BY SPOON-FED PLANTS

(Continued from page 109)

fact that in the far north, where the sun is never very bright, but the days are long during the growing season, plant life springs up as if by magic.

An even more important discovery in this novel laboratory shows that plants which can stand a moderate temperature under one intensity of sunlight, can stand a much higher temperature in brighter light. Dr. Davis believes that this question of the relationship of light intensity and heat has an important bearing on the failure of lettuce, cabbage, and similar truck crops to form solid heads.

**T**HIS wheat experiment likewise finds practical application in the greenhouses of the nation. Greenhouse owners often try to maintain a constant temperature throughout the year. But these results suggest that greenhouse temperatures should be lowered in winter, when the sun's intensity is low, since high temperatures without adequate sunlight affect plants much as a fever affects human beings, forcing the cell-building processes to proceed faster than food can be taken in.

While some of these experiments look toward purely scientific findings—the facts of plant physiology—others find ready application in higher production at lower costs and in combating disease.

For instance, Prof. W. C. Gehricke, also of the University of California, for several years sought a means of improving the quality of tomatoes at lower cost. Year after year, he set out young plants in a waterproof box two and one-half feet wide and ten feet long. He tried them in various kinds of materials, from sawdust to excelsior, and finally hit on a winning combination.

When I visited the laboratory, I saw the box filled with sturdy plants which had been set out two months earlier. They had attained a height of nearly two feet. The stalks were supported by a layer of excelsior two and one-half inches thick, resting on a screen of chicken wire. Their roots extended into the water, which contained a balanced nutrient solution of calcium nitrate, potassium nitrate, magnesium sulphate, potassium phosphate, and ferric tartrate, the elements necessary to plant growth.

Beyond "feeding" the plants one pint of the solution twice during their growing season and keeping the twenty-five gallons of water at a temperature of about seventy-two degrees, with room temperature between eighty-five and ninety degrees, the scientist gave them little attention. On the basis of last year's yield, 365 pounds from the small tank, tomatoes so grown are expected to produce the astounding total of 350 tons an acre. Now, for the first time, at Los Angeles and Santa Cruz, Calif., growers are trying out the "water culture" methods on a large scale.

**B**Y A similar method, Dr. Gehricke has produced astoundingly large quantities of potatoes, radishes, and carrots in his beds of excelsior.

Nor are these all. As I walked through the near-by greenhouses, I saw sunflowers growing in bottles, fed by carefully balanced nutrient solutions and aerated through rubber lines leading into the water solutions; sequoias, taken from cuttings and now two years old, growing in corks, their roots floating in water contained in shallow pans; barley, in various stages of hardness.

The barley, I learned, has yielded some odd facts. From several plants nitrate was withheld. With almost human intelligence, the tender young roots shot out almost overnight to surprisingly great lengths, actually searching for the missing element. Others, denied

iron, died; yet, when only one drop of iron was added to the water for one night, plants of the same age absorbed enough to carry them through to maturity without turning yellow. Others, lacking sulphate and magnesium, grew until they started to form heads; then they, too, died.

Tomatoes, sunflowers, and squash were serving as plant guinea pigs in experiments to find a cure for "little leaf," a disease resulting from deficiency of zinc, which causes leaves, particularly at the end of apricot-tree branches, to become yellow and sickly. Some were growing with lead added to their diets, others without. By changing diets, the scientists are trying to produce "little leaf" in these garden plants. Then they will know the cause of the disease, and how to combat it.

**S**EVERAL years ago, a disease known as chlorosis attacked fruit trees in a central California valley. Caused by an excess of lime in the soil, this disease interfered with the iron metabolism and caused leaves to turn yellow, thereby limiting their ability to take food from the air. Investigation revealed that the disease was attacking trees all the way from Kansas to the Pacific Coast.

Into the hands of Dr. J. P. Bennett, professor of plant physiology, the problem fell. To solve it, he first recognized he must study the relationship between inorganic nutrition and chlorosis, and in order to control all factors he set out sixty French prune and pear trees, taken from nursery stock, in ordinary garbage cans. Each can was painted inside with asphalt and marine varnish to prevent rust, and packed with moss, which kept down temperature during the summer. Into each was poured twenty-five gallons of water and a small quantity of a nutrient solution, containing calcium, magnesium, potassium, iron, sulphur, phosphorus, nitrogen, and manganese. In addition, oxygen was supplied to the roots by means of air bubbling up through the water.

From time to time, for four years, Dr. Bennett has changed the balance of the food fed to these trees, maintaining some in an acid diet, others in an alkaline solution, while still others were kept neutral. Once each week he takes a sample of the solution, tests it, and re-adjusts the diet, feeding the trees from a glass tube much as a new-born babe sometimes takes liquid from a medicine dropper. For two years, these water-raised trees have borne luscious fruit, many of them entirely free from disease.

"Whereas soil can only supply a few elements to a tree," Dr. Bennett told me, as we examined the sturdy roots of one specimen, "here we can control all factors. For instance, if these trees were growing in a soil containing five percent of lime, that would mean that over the area required, the upper foot of soil alone would contain 200,000 pounds of lime. To neutralize such a soil, we would have to add an even greater amount of sulphuric acid. Here we can accomplish this around individual trees with only a spoonful of acid."

**T**HESE remarkable experiments, while pointing a way to high productivity of fruits and vegetables, do not end here. Other experts in plant nutrition in the same laboratories are studying the effects of rare and little known elements on plant life, the food-supplying capacity of the soil, and the chemical composition of tissues within the plants themselves.

From these researches will come further and even more startling facts about the plants which furnish the food elements and without which neither beast nor man would be able to continue the fundamental life processes.

## HOME EXPERIMENTS SHOW ODDITIES OF WATER

(Continued from page 53)

for making small quantities of distilled water.

Among the interesting commercial applications of chemicals that hydrolyze, or interact with water, is their use in fighting fire. Apparatus employing this principle is easy to reproduce in the laboratory on a miniature scale.

Some types of fire extinguishers contain baking soda and sulphuric acid, which are mixed when the container is inverted, generating a frothy stream of carbon dioxide bubbles that smother the blaze. Another variety of extinguisher dispenses with sulphuric acid. Instead, a solution of aluminum sulphate, which behaves like an acid as a result of hydrolysis, is used. The baking soda, or sodium bicarbonate, is retained and is supplemented by an extract of licorice that serves as a foam-producing agent.

**W**HEN the aluminum sulphate solution and the bicarbonate solution mix, carbon dioxide gas is formed. Another product is a jellylike precipitate of aluminum hydroxide, which is rendered stiff and tough by the foaming agent. In consequence, a fire is extinguished by coating it with a blanket of tough bubbles of carbon dioxide gas.

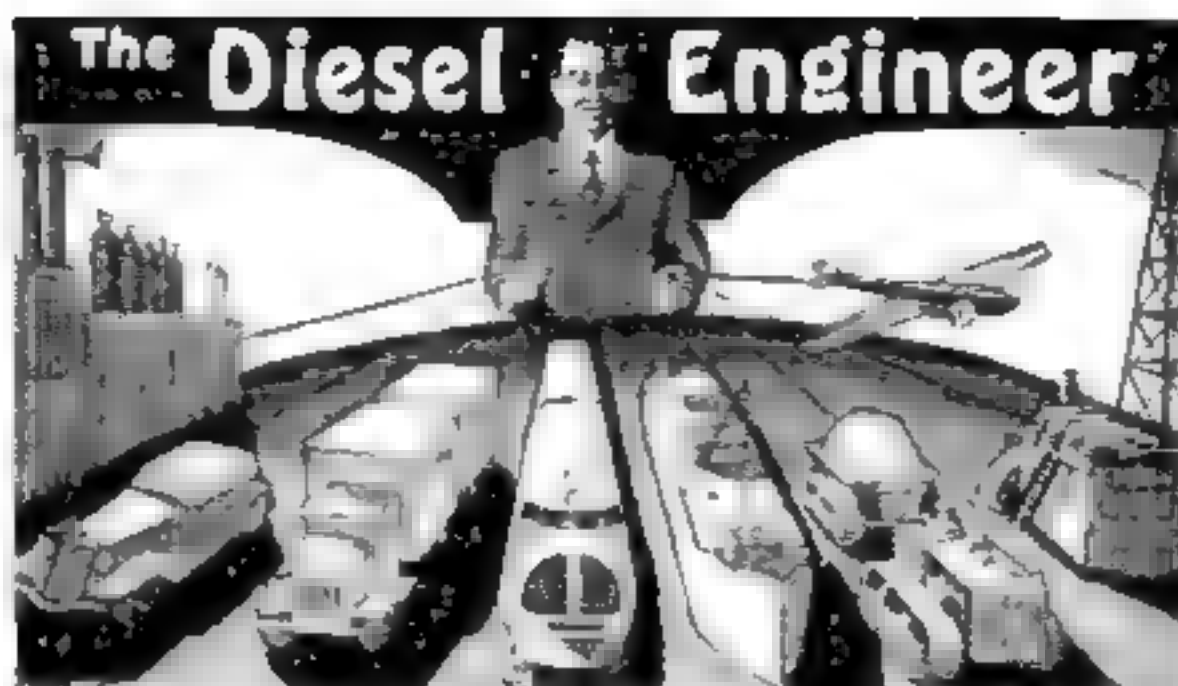
A model illustrating this principle may be assembled from a U tube of about half-inch diameter, a small T tube, and a pair of large funnels. The funnels serve as containers for the two solutions, and should be joined to the T tube, where the liquids mix, by rubber tubing. Hang the U tube over the side of a large tin can, which will be used to simulate a flaming oil tank, and connect it to the remaining branch of the T tube with a one-hole stopper. (A metal or rubber tube may replace the glass U tube, if you wish; it should be of large diameter to accommodate the increase in volume of the mixed solutions.) Tighten a pinch clamp or a screw clamp, preferably the latter, over both sections of rubber tubing leading from the funnels, and you are ready to fill them with the necessary solutions.

The exact strength of the sodium bicarbonate and aluminum sulphate solutions is not important; ten to twenty-percent solutions will work well. To the bicarbonate solution, add a gram or two of saponin, or a little glue, gelatin, or powdered soap, to serve as the foaming agent. Then place one of the solutions in each funnel.

A half spoonful of alcohol, placed in the tin can and ignited, will give a realistic likeness of an oil-tank fire. Open the screw clamp, and the fire-fighting solutions will come in contact with each other, ejecting a copious foam through the U tube and quickly extinguishing the blaze. Make sure that the rubber tubing is entirely filled with the solutions, as one of them may fail to flow if air bubbles are trapped. The funnels should be supported well above the level of the tin-can "tank" to give the liquids sufficient hydraulic head, or pressure.

**B**EFORE we leave the subject of hydrolysis, it is interesting to note the behavior of magnesium chloride, a salt found in sea water. So marked is the interaction of this compound with water, forming hydrochloric acid, that hydrogen gas is evolved when the solution is boiled in iron or steel containers. The acid produced by hydrolysis attacks the metal, and this is one of the reasons why sea water cannot be used to generate steam in the boilers of ships.

Many of the physical properties of water have been described and illustrated with experiments in previous articles of this series. Something new to try, however, is a test that demonstrates how (Continued on page 112)



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## HOME EXPERIMENTS SHOW ODDITIES OF WATER

(Continued from page 111)

water vapor condenses in the air to produce fog, and shows the curious part that dust plays in the process.

A handy accessory for this and other experiments is a homemade vacuum pump, which you can improvise by reversing the leather washer in a small bicycle-tire or football pump (so that the pump will suck when the handle is pulled) and soldering the valve stem from a discarded inner tube to the end of the pump cylinder.

Fit a pair of bottles with two-hole stoppers carrying L-shaped tubes of glass or metal, and join the bottles through one set of L's with a short length of rubber tubing. Connect the vacuum pump to the remaining L of one of the bottles, which is left empty. Place several drops of water in the other bottle and attach a rubber tube fitted with a pinch clamp to its unused L.

CLOSE the pinch clamp and draw the air from the bottles with a few strokes of the homemade vacuum pump. (If the pump is not fitted with the valve stem, but its washer is reversed as described above, the experiment will still work; a single stroke of the pump produces a slight vacuum that is sufficient to show the fog phenomena. In fact, even sucking the air out with the lungs will do.)

Now open the pinch clamp, letting air rush into the bottles. Water vapor in the bottle nearest the inlet will condense, forming a fog. No fog forms in the bottle nearest the pump, which contains little or no water vapor.

Water vapor, however, is not the only requirement for producing fog. Repeat the experiment with a tube of absorbent cotton attached to the inlet tubing. This time, no fog will be produced even in the bottle containing the water. The cotton strains out dust particles from the incoming air, and the experiment demonstrates that these particles of dust are required as nuclei or starting points for water vapor to condense into the droplets of moisture that constitute fog.

This phenomenon calls to mind the behavior of supersaturated solutions of certain salts, which crystallize spontaneously upon the introduction of a tiny crystal of the same material or a particle of dust. If you heat crystals of sodium thiosulphate (photographer's hypo) or sodium acetate in a flask, without adding water, you will obtain a thick syrup. Let it cool without being shaken and it will remain a liquid. Now allow a minute crystal of the material used in the experiment, or a particle of dust or dirt, to fall into the liquid. Instantly it will solidify into a mass of crystals. The foreign particle serves as a nucleus for the beginning of crystallization.

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## COMMON SENSE MAKES GOOD DRIVERS

(Continued from page 58)

glance in the rear-vision mirror before I start up," Pendleton said, "so you haven't got anything on me there, anyhow."

"So do most people," Hunter agreed. "But how many of 'em wait long enough to be sure there's no car passing right close, in the blind spot of the mirror? An inside rear-vision mirror only shows you the road some distance back through the rear window of your car. If a car is quite far out in the road, it passes out of view in the rear-vision mirror quite a bit before it actually comes by you. Lots of fenders get smashed because drivers forget that. Unless you poke your head out of the window and look back, you can't be sure—unless you wait for several seconds after you see that the road is clear in the mirror, so that if any car is in the blind spot it will have a chance to pass before you swing out.

"NOW, here's the other side of it," Hunter went on, slowing up, as they swung around a corner into a street that was lined with parked cars on both sides. "Common sense should tell you that there may be a dumb-bell among the owners of these parked cars—and especially in a place like this, where all the cars are parked with their noses to the curb. Any one of them is likely to back out right into you. Of course, if there isn't any traffic coming the other way, you don't have to be quite so careful. Then, if you keep an eye on the row of parked cars, you can swing over if one starts to back out.

"Now," he continued, as they turned into the state road and rapidly overhauled a couple of heavily laden trucks, "I've found that I'm not so good on judging the relative speeds of oncoming cars, so I won't attempt to pass those trucks until there is no possible chance that a car coming the other way will get me in a jam. I certainly wouldn't attempt it, under any circumstances, while we're going around this curve.

"Incidentally," Hunter continued, after they had come to a straight stretch and passed the trucks, "lots of drivers get the idea that they can judge the speed of an oncoming car to a hair when they really can't do it any better than I can. If you think you're hot stuff at that game, just get somebody to hold the watch on you while you estimate how long it will be before any given car passes you, how long it will take you to reach some point quite a distance down the road from where you are, and how long it will take you to swing out and pass a car and swing back onto your own side of the road again. You'll probably be astonished how far off your estimates will be.

"IF YOU have a stop watch, you can time it yourself. If you have any natural aptitude for judging speed and distance, timing that way will help bring it out, and if you haven't, it will show you up to yourself without running any risks of a head-on collision."

"I get you," said Pendleton. "If you can estimate just how long it will be before the car coming the other way will reach you, and how long it will take you to pass the car ahead, and do it accurately, then the difference in time is your margin of safety. That's a swell idea. I'll try timing myself."

"Now, here's another problem where common sense wins out most times," Hunter said, as they pulled up behind a car that was rolling squarely down the center of the road.

"In a case like this, sound your horn once. If the driver pays no attention, sound it again in a few seconds. Remember that he is intent on his driving, and may not hear you at first. If he doesn't pull over after the third attempt, crawl up (Continued on page 114)



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## COMMON SENSE MAKES GOOD DRIVERS

(Continued from page 113)

close behind and stick right there. The kind of a driver who sticks to the center of the road usually is a bit nervous about a car following too closely, and he'll either pull over and let you go by, or speed up so it isn't necessary. Of course you've got to keep your eye peeled for what's in front of the other car when you're close up like that, so you'll spot any danger as soon as he does and put your brakes on in time with him. And, naturally, you'll drop back a bit if for any reason you can't see what's ahead of him. Furthermore, it stands to reason that keeping too close to the car ahead is mighty risky if your brakes aren't in top-notch shape—but, then, you shouldn't be on the road anyhow if they aren't!

"AT NIGHT, it isn't safe to get so close, but you can turn on your distance headlight beams and that will generally get results." "Not if he has his rear curtain pulled down," Pendleton observed.

Hunter laughed. "That makes him a double dumb-bell, so you'll have to be extra careful. A lot of drivers pull down the rear curtain to cut out the glare of headlights in their rear-vision mirrors, but it doesn't strike me as the safest thing to do. It's always better to know what's going on behind your own car. 'I'm not saying that skill in driving isn't worth having,' Hunter explained. 'Knowing exactly where your wheels are is a help sometimes. Watch what happens to that empty cigarette package down the road.'"

Pendleton spotted the package, and looked back after the car had passed. The paper was completely flattened.

"Any skillful driver should be able to make either front wheel pass over any given spot, but many drivers can't come within six inches of a target with either wheel.

"Here's another point," Hunter went on, as they rounded a curve and came in sight of a crossing just as the light turned red. "Common sense will tell you it's wise to take your foot off the throttle and coast to a stop in a case like this. It saves the brakes. Furthermore, when you do have to jam on the brakes, always try to do it in such a way that you have several yards to spare. After your car has practically stopped, let up on the brake enough so she'll slide forward in that extra safety space. If the fellow behind you hasn't good brakes, he may not be able to stop as quick as you can, but by doing things this way you'll make him jam his brakes on in time so that he'll either stop before he hits you, or he'll bump you while your car is still moving and the shock won't be as great."

"I CAN see how that would work out," Pendleton said. "If you were, say, fifty feet or so in front of him when you slammed on the brakes, and his brakes weren't as good as yours, he'd come right up on you, but just before he'd slam you, you'd ease ahead and let him stop in the extra few yards. That's a good trick, too."

They returned to the Model Garage just as Gus was giving the final polish to the lacquered spot.

"I won't stop now, Gus," Hunter said. "The rattle I wanted you to find seems to have disappeared. When it comes back, I'll drop in again."

"That old geezer is some slick driver, all right," Pendleton admitted, as he climbed into his own car, "and he's no slow poke, either. We were hitting fifty on the state road."

"But he isn't as good as you are, eh?" Gus asked, with a twinkle in his eye.

"He's better," growled Pendleton. "But he won't be for long. I can mix common sense with my driving just as well as he can!"

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## MEMORY EXPERTS MADE TO ORDER

(Continued from page 21)

name that lumps together a set of entirely distinct faculties. You might be able to call every man in the state of Nevada by name—as one of its early governors was reputed to be able to do—and still forget a pressing business appointment. All the Einstein formulas in the theory of relativity may come readily to your mind, yet you may be unable to recall where you left your rubbers. Memory for scenes and for music, or for faces and voices, are utterly unrelated things.

LOOK into the mechanism by which your brain files things away for future reference, and you will understand why this is so. Quite likely, your memory works altogether differently from the next man's. That individuals differ markedly in the way they think and imagine was first proved by the great British experimenter, Francis Galton. When he questioned people about their power of conjuring up mental "photographs" of things they had seen, some maintained that they could picture an object in their mind's eye as vividly as if it were directly before them. Others denied having any such power and refused to believe that anyone else possessed it.

To account for what he observed, Galton classified his subjects into "visiles," who remembered pictorial images; "audiles," who recalled sounds; and "motiles," whose memory was for movements. Modern experimenters qualify this idea by admitting your right to some share of each type of ability, but agree with Galton that one faculty usually predominates—especially when you are confronted with a given kind of task. A common example is the person who remembers actual things by mental pictures, and words by their sounds. Occasionally a person is found who is almost exclusively a "visile," an "audile," or a "motile."

These differences show up strikingly in an interesting test that psychologists have devised—the memorizing of a series of nonsense syllables like "bim, tup, lor, wex." The strange-looking words, pronounceable but meaningless, are used in order to start the subject with absolutely unfamiliar material.

Subjects with "photographic" minds commit these syllables to memory as mental pictures. This is revealed by the fact that they can spell them forward or backward with equal ease.

Visualizers also disclose themselves by tending to mistake words that look alike, while "audiles," or subjects with "sound-track" minds, confuse words that sound alike. Using ordinary words to make the example clearer, the "visile" might recall, "phantom," if dimly remembered, as "phaeton"; the "audile," as "fan-tan." "Audiles" are greatly disturbed by noises that do not bother the visualizer in the least. They learn more easily when words are read to them, instead of shown to them.

MOST frequently encountered of all are subjects who learn the syllables by imagining, or actually trying, the "feel" of mouth and tongue movements required to say them. These "motile" or muscular memorizers learn best when they actually pronounce the words aloud. Make one of them whistle or swallow rapidly, and you will paralyze his ability to memorize words, since he cannot go through the necessary motions!

Still other types of memory are known. A few people have the power of remembering tastes, and others are able to recall odors. These cases are rare.

Practice will improve any one of these types of memory, but practicing one of them will not help another. Which kind is best?

The visualizer has an obvious advantage in remembering faces, (Continued on page 116)

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# Memory Experts Made to Order

(Continued from page 115)



Here are the ten people you met on page 21—and five more who have joined the party. How many can you identify? Write the name of each one that you recognize on the line corresponding to the number of the picture; for the new arrivals, just write "stranger"

1 _____	6 _____	11 _____
2 _____	7 _____	12 _____
3 _____	8 _____	13 _____
4 _____	9 _____	14 _____
5 _____	10 _____	15 _____

pictures, scenes; the "audile" in identifying voices and recalling music; the "motile" in tasks requiring accurate movements from memory, such as "touch" typewriting—or making a midnight trip to the ice box through a darkened house without barking his shins or missing the bottom stair. Committing names or telephone numbers to memory, on the other hand, permits a choice of methods. In general, the "photographic-minded" person learns things more slowly, but recalls them more confidently and accurately than the person with the "sound-track" mind or the "muscular memorizer."

**WHICHEVER** method you use, here are a few general rules that psychologists offer to help you, both in individual memorizing tasks and in training your memory to give you better all-around service in the future.

First, in memorizing a piece of material, tackle it as a whole and not in sections. Suppose that you want to learn by heart a poem of six stanzas. You might imagine it would be easier to memorize, say, a couple of stanzas at a time—committing the first, middle, and last parts of the poem to memory at three separate sittings. Nevertheless, experiments show that this method is wrong. Read the poem right through from start to finish, as many times as necessary, and you will learn it in connected form—which is the way that you want to—and with greater efficiency. The same applies to a selection of text or any other material.

Avoid "cramming." In the example just given, you will fix the poem far more firmly in your mind if you read it through twice

each evening for a week than if you go over it fourteen times in one night. A wise after-dinner speaker does not court the embarrassment of forgetting his intended remarks by trying to memorize a speech in a single sitting; a few rehearsals at one or two-day intervals, for a week or so preceding the occasion, make him letter-perfect.

Don't try too hard. Laboratory experiments have proved that mental tension, produced by "over-trying," definitely slows down the process of learning instead of speeding it up.

Have confidence in your memory. "Every time a person remarks that he has a memory like a sieve," declares Robert H. Thouless, British lecturer on psychology, "he is knocking one more hole through its bottom."

Don't attempt spectacular feats of memory at the outset. The ability to perform them is the reward of long-continued effort. As you keep practicing, however, you will be encouraged by the steady improvement in your powers of recollection.

**A**VOID "mental crutches," or artificial aids to memory, such as associating colors with numbers in order to remember the figures better. This is bad because it puts your mind to unnecessary labor in handling two kinds of material that have no natural relation to each other. It is entirely possible to learn and recognize familiar patterns in figures themselves. If your education had led you to study combinations of digits instead of combinations of letters, you could read long numbers at a glance, just as you now read long words without stopping to examine the individual letters.

This proved to be the secret of the number wizardry that Dr. Finkelstein displayed to the Ohio State University experimenters. He had simply learned to view a long number as a string of smaller, three-digit figures, which were as easily recognizable to him as English words are to most people. It gave him no more trouble to memorize a number like 312655135254697255817 than you would have in committing to memory the line "cab fee ace bed fig bee hag." Just as the patterns of words stand out even when run together—"cabfeeacebedfigbee hag"—so familiar patterns of three-digit figures stood out to his eye. Even learning the vocabulary of numbers that he uses does not seem so difficult when you realize that there are only 900 three-figure numbers to become acquainted with, compared to the tens of thousands of different words used in everyday English speech.

**A**NOTHER interesting aid to memory is suggested by recent research. The best time to memorize anything is just before you go to sleep, Dr. H. M. Johnson, American University psychologist, concludes from experiments here and abroad. In tests conducted by Joseph F. O'Brien, graduate student at American University, Washington, D. C., a group of undergraduates learned a memory assignment of nonsense syllables immediately before bedtime, and retired promptly for eight hours' rest. Just twenty-four hours after the lesson, they tried to recall as much as possible of what they had learned. The experiment was also tried at other times of day. So striking was the difference in performance, Dr. Johnson declared, that anyone would be justified in wagering 100,000 to one that it could not be due to chance. The "bedtime memorizers" scored consistently twenty to thirty percent higher than the rest. Apparently, material that has just been memorized "sinks in" most effectively in the drowsy period just before actual slumber. The benefit was lost, Dr. Johnson observed, if even as little as two hours intervened between the time of study and bedtime.

The most important fact brought out by all of these recent studies is that memory is not the chance possession of a few favored individuals, but may be cultivated by anyone who goes about it scientifically and has the desire and the patience to practice regularly. Try the suggestions given here, and you will be surprised at your own improvement.

You may find that you have a natural aptitude for one of the types of memory enumerated above. If so, you may be able to find some specially useful or entertaining way of exercising it. As for your weak points, they can be strengthened by a little exercise.

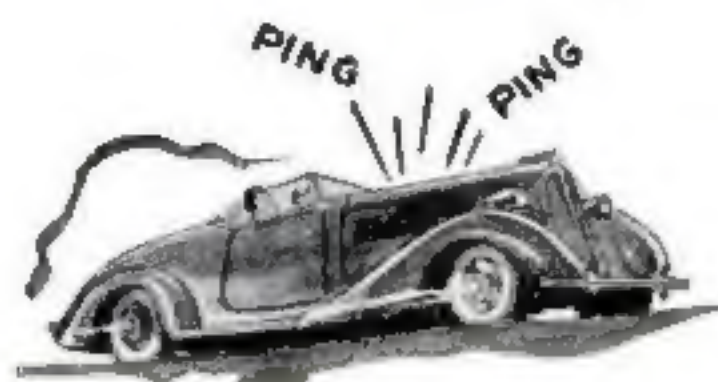
## Do You Remember?

After looking for fifteen seconds at the picture at the bottom of page 21, see how many of these questions you can answer:

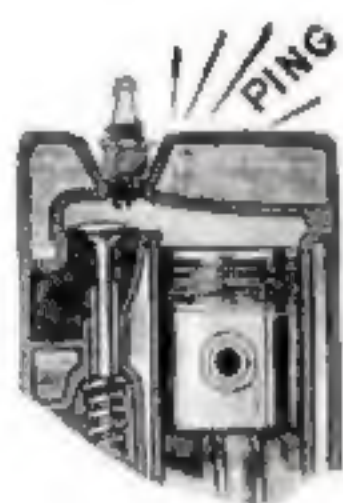
- Was the auto that went over the curb a closed car or an open one?
- What kind of a store did it strike? What happened to the other car?
- Was the lamp post at the corner still standing?
- What were passers-by doing?
- What happened to the fire hydrant?
- Was anyone lying in the gutter beside it?
- Was there a policeman in sight?
- Were any windows broken?
- How many eyewitnesses were near-by?

# HERE'S THE LOW DOWN

in 43 seconds



**BEWARE** a "pinging" sound this summer when you "step on the gas" for pick-up, or hills. It is your engine's way of saying: "I feel hot weather, too. I'm *losing* power, *wasting* gas and *overheating*. Give me better gasoline."



**KNOCK** is the name of that warning "ping." It occurs when a gasoline

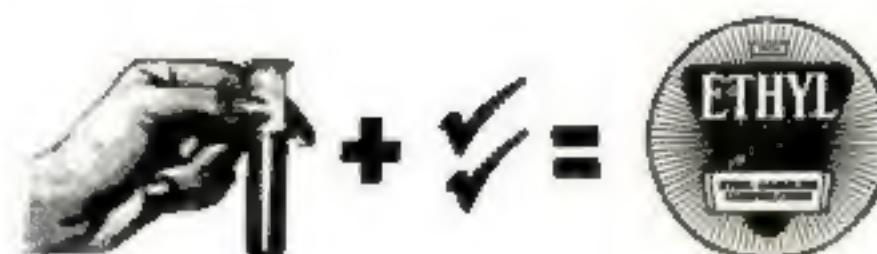
breaks down (burns too quickly) under the heat of a modern high compression engine.

Cars built in recent years have high compression engines. And in summer the knocking evil is at its worst because hot weather increases engine heat.



**THE CURE**—and preventive—of knock is better gasoline. That is why most oil companies now improve gasoline by adding anti-knock fluids (containing tetraethyl lead) made by the Ethyl Gasoline Corporation.

They recommend, as their *best* fuel for summer driving, special gasoline sold at pumps marked "Ethyl" on the base or globe.



**YOU GET** at the "Ethyl" pump:

- ✓ Enough anti-knock fluid to stand up under the highest engine compression on the hottest day.
- ✓✓ All-round quality that is double-checked—by the oil companies and the Ethyl Gasoline Corporation—at the refinery and at the pump.



**GIVE YOUR CAR** the coolest fuel this summer. Avoid knock — power loss, gasoline waste and overheating. Get more power from each gallon of gasoline you buy!...

**NEXT TIME GET ETHYL**

**IT PAYS TO HAVE THE LOW DOWN ON HIGH COMPRESSION**



**ON THE WALDORF-ASTORIA ROOF... FAR ABOVE NEW YORK.** In the cool and charming Starlight Roof, worry and rush are quickly forgotten as the guests enjoy the entertainment and dancing and revel in delicious foods. Here again Camels are the preferred cigarette. The *maitre d'hôtel* of the Starlight Roof—René Black—says: "I see Camels everywhere on our tables. Camels are the favorite at the Starlight Roof."

**MRS. FRANK SMITH**, typical homemaker, says: "When I smoke Camels at mealtime, my digestion works smoothly."

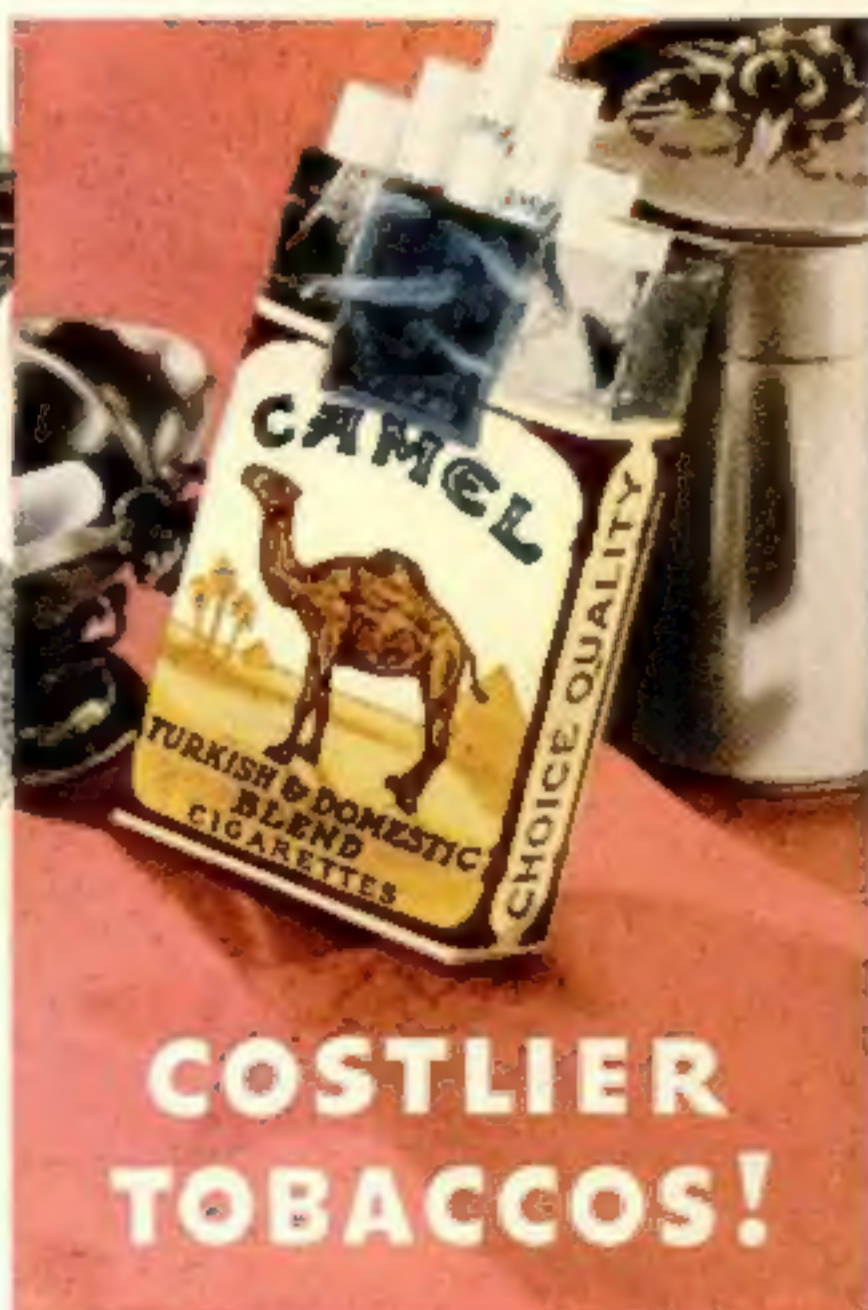
**JOHNNY REVOLTA** says: "No matter what I eat, or where, Camels make my meals digest better."

© 1936, R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

## Let Camels add to your Enjoyment... and "For Digestion's sake—smoke Camels"



**COMMANDER GEORGE M. DYOTT**, explorer, who has existed on difficult jungle diets, says: "Smoking Camels is good for my digestion. Food tastes better—digests easier."



In smoking Camels between courses and after meals, you make this agreeable discovery: Camels stimulate the digestive process.

A richer flow of digestive fluids occurs, thanks to Camels. Camels offset the effects of nervousness and strain, which slow down this activity. You feel a cheering "lift," a sense of well-being.

Big Bill Tilden, Helen Hicks, Lou Gehrig, Helene Madison — all smoke Camels. Camels never upset your nerves or tire your taste. Camels set you right!

CAMELS ARE MADE FROM FINER, MORE EXPENSIVE TOBACCOS—TURKISH AND DOMESTIC—THAN ANY OTHER POPULAR BRAND.